

Dräger Medical, Inc.



Operator's Instruction and Setup Manual

Part No. 4114107 Rev. B

Narkomed M Anesthesia System
Part No. 4114179

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Safety Summary

Operator's Responsibility for Patient Safety

Draeger Medical, Inc. anesthesia products are designed to provide the greatest degree of patient safety that is practically and technologically feasible. The design of the equipment, the accompanying literature, and the labeling on the equipment take into consideration that the purchase and use of the equipment are restricted to trained professionals, and that certain inherent characteristics of the equipment are known to the trained operator. Instructions, warnings, and caution statements are limited, therefore, to the specifics of the Draeger Medical, Inc. design. This publication excludes references to hazards that are obvious to a medical professional, to the consequences of product misuse, and to potentially adverse effects in patients with abnormal conditions. Product modification or misuse can be dangerous. Draeger Medical, Inc. disclaims all liability for the consequences of product alterations or modifications, as well as for the consequences that might result from the combination of Draeger Medical, Inc. products with products supplied by other manufacturers if such a combination is not endorsed by Draeger Medical, Inc..

The operator of the anesthesia system must recognize that the means of monitoring and discovering hazardous conditions are specific to the composition of the system and the various components of the system. It is the operator, and not the various manufacturers or suppliers of components, who has control over the final composition and arrangement of the anesthesia system used in the operating room. Therefore, the responsibility for choosing the appropriate safety monitoring devices rests with the operator and user of the equipment.

Patient safety may be achieved through a variety of different means depending on the institutional procedures, the preference of the operator, and the application of the system. These means range from electronic surveillance of equipment performance and patient condition to simple, direct contact between operator and patient (direct observation of clinical signs). The responsibility for the selection of the best level of patient monitoring belongs solely to the equipment operator. To this extent, the manufacturer, Draeger Medical, Inc., disclaims responsibility for the adequacy of the monitoring package selected for use with the anesthesia system. However, Draeger Medical, Inc. is available for consultation to discuss monitoring options for different applications.

Limitation of Liability

Draeger Medical, Inc.'s liability, whether arising from or related to the manufacture and sale of the products, their installation, demonstration, sales representation, use, performance, or otherwise, including any liability based upon Draeger Medical, Inc.'s product warranty, is subject to and limited to the exclusive terms of Draeger Medical, Inc.'s limited warranty, whether based upon breach of warranty or any other cause of action whatsoever, regardless of any fault attributable to Draeger Medical, Inc. and regardless of the form of action (including, without limitation, breach of warranty, negligence, strict liability, or otherwise).

Draeger Medical, Inc. shall in no event be liable for any special, incidental, or consequential damages (including loss of profits) whether or not foreseeable and even if Draeger Medical, Inc. has been advised of the possibility of such loss or damage. Draeger Medical, Inc. disclaims any liability arising from a combination of its product with products from another manufacturer if the combination has not been endorsed by Draeger Medical, Inc.. Buyer understands that the remedies noted in Draeger Medical, Inc.'s limited warranty are its sole and exclusive remedies.

Furthermore, buyer acknowledges that the consideration for the products, equipment, and parts sold reflects the allocation of risk and the limitations of liability referenced herein.

Recommendations

In the interest of patient safety, Draeger Medical, Inc. strongly advocates the use of an oxygen analyzer, pressure monitor, and either a volume monitor or an end-tidal CO₂ monitor in the breathing circuit at all times.

Because of the sophisticated nature of Draeger Medical, Inc. anesthesia equipment and its critical importance in the operating room setting, it is highly recommended that only appropriately trained and experienced professionals be permitted to service and maintain this equipment. Contact a qualified technical service representative for service of this equipment.

Draeger Medical, Inc. also recommends that its anesthesia equipment be serviced at three-month intervals. Periodic Manufacturer's Service Agreements are available for equipment manufactured by Draeger Medical, Inc.. For further information concerning these agreements, contact the Draeger Medical, Inc. Technical Service Department at (800) 543-5047.

Restriction

Federal law restricts this device to sale by, or on the order of, a physician.

Symbol Definition

The following symbols appear on the label on the back of the Narkomed M and on its containers.



CAUTION: Refer to accompanying documents before operating equipment.



CAUTION: Risk of electric shock, do not remove cover. Refer servicing to a qualified technical service representative.



Degree of protection against electric shock: Type B.



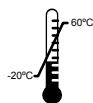
WARNING: This end up.



WARNING: Handle with care.



WARNING: Keep dry.



WARNING: Minimum and maximum storage temperatures.

Warnings and Cautions

This manual contains warning and caution statements about the Narkomed M.

- *Warning* statements provide important information that, if ignored, could lead directly to a patient's injury.

- *Caution* statements provide important information that, if ignored, could lead directly to equipment damage and indirectly to a patient's injury.

Warnings

The instruction manual provides important information about patient and operator safety. Anyone involved with the setup, operation, or maintenance of the Narkomed M anesthesia system must be thoroughly familiar with this instruction manual.

This anesthesia system will not respond automatically to certain changes in patient condition, operator error, or failure of components. The system is designed to be operated under the constant surveillance and control of a qualified operator. Constant surveillance is necessary to ensure patient safety.

Do not attach third-party components to the anesthesia machine, ventilator, or breathing system (except for certain approved exceptions). These devices may affect the safe operation of the anesthesia machine. Contact the Draeger Medical, Inc. Technical Service Department at (800) 543-5047 for further information.

When moving the anesthesia machine, remove all monitors and equipment from the top shelf, remove the absorber system, and use only the machine handles to push or pull the unit. The anesthesia machine should only be moved by people who are physically capable of handling its weight. Draeger Medical, Inc. recommends that two people move the anesthesia machine to aid in maneuverability. Exercise special care so that the machine does not tip when moving up or down inclines, around corners, and across thresholds (for example, in door frames and elevators). Do not attempt to pull the machine over any hoses, cords, or other obstacles on the floor.

The Narkomed M patient breathing system must not be used in conjunction with any additional components that establish a flow direction.

Hoses and bags attached to the 22 mm hose terminals of the inspiratory valve, expiratory valve, ventilator hose connect, and breathing bag mount must comply with current ANSI standards.

Oil and grease may combine explosively with oxygen or nitrous oxide. For this reason, oil and grease must never come in contact with pipelines, cylinders, cylinder valves, gauges, fittings, etc., that conduct oxygen or nitrous oxide within the machine. For further information regarding safety precautions in the use of medical gases, consult Compressed Gas Association pamphlet P-2 and appropriate sections of the National Fire Protection Association Standard 99.

In circle systems, the gas mixture in the patient circuit is not necessarily the same as that in the fresh gas flow. This is particularly true at low fresh gas flow rates when the patient rebreathes a significant amount of previously exhaled gases. It is important that the gas mixture in the patient circuit is monitored and that the fresh gas flow is adjusted to meet the requirements of the patient and to compensate for patient intake, any system leakage, or any gas drawn through sample lines and not returned.

Waste gas scavenging systems used with Draeger Medical, Inc. absorber systems must have safety features to ensure that excessive subatmospheric pressure (lower than $-0.5 \text{ cmH}_2\text{O}$) and excessive positive pressure (higher than $+0.5 \text{ cmH}_2\text{O}$) are not possible at the connection point.

Because the vaporizer funnel filling system does not limit the type of agent poured into the vaporizer, using an agent monitoring device is recommended to verify the agent.

Do not inhale anesthetic vapors while filling or draining the vaporizer. Uncontrolled inhalation of anesthetic vapors is injurious to health.

Do not insert any additional components into, or modify, the anesthesia system after any checkout procedure is started. Doing so can invalidate the checkout results and could affect the patient's safety.

There is a possible explosion hazard if the Narkomed M is used in the presence of flammable anesthetics.

Cautions

Although the Narkomed M is designed to minimize the effects of ambient radio-frequency interference, machine functions may be adversely affected by the operation of electrosurgical equipment or shortwave or microwave diathermy equipment in the vicinity.

Communications with external equipment may be temporarily affected by electromagnetic interference due to the use of electrosurgical equipment.

Do not place sensitive electronic equipment on or adjacent to the display screen.

The vaporizer is specifically designed and calibrated for one particular anesthetic agent. Do not fill a vaporizer with any other anesthetic.

Do not place more than 10 pounds on top of the Narkomed M.

Always operate the Narkomed M on a level surface.

Safety Summary

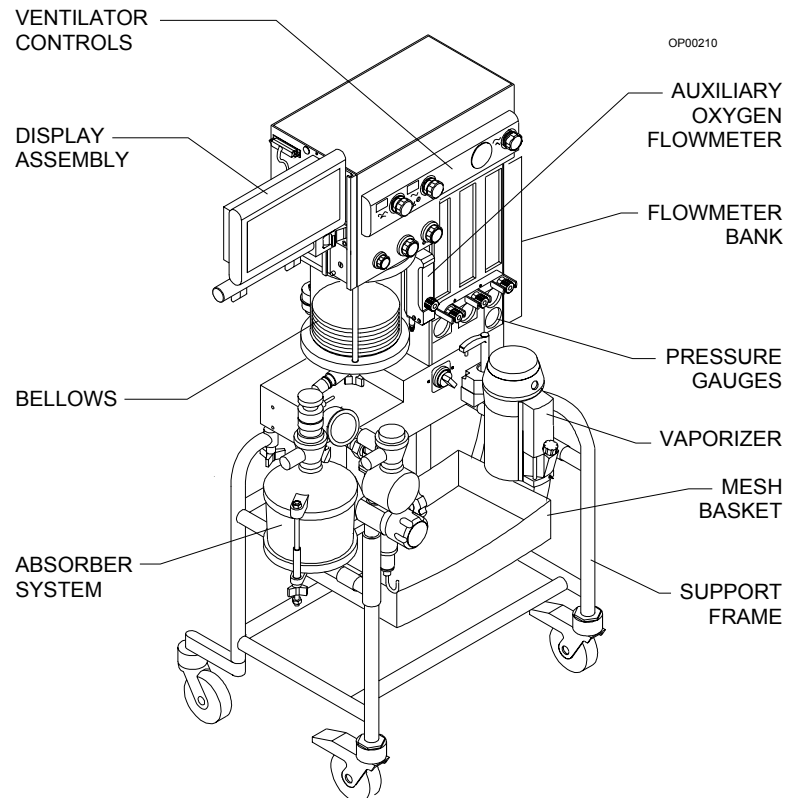
Before moving the machine, remove the vaporizer, items from the shelf and the display arm, and secure the absorber against the left side of the Narkomed M.

General Description

Overview

The Narkomed M is a compact, lightweight, continuous flow anesthesia system. All Narkomed M machines are equipped with a monitoring system and pneumatic circuitry for delivering gases and anesthetic vapor for adult and pediatric patients.

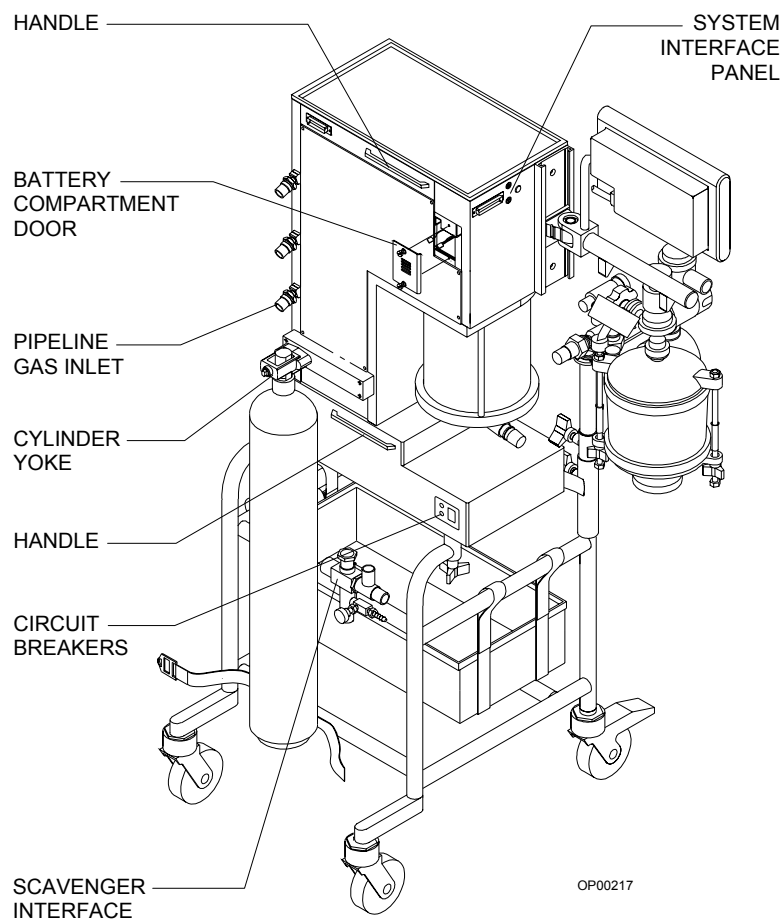
Figure 2-1. Narkomed M Front View



The Narkomed M consists of these major systems:

- gas delivery
- anesthetic vaporizer
- absorber
- scavenger
- anesthetic ventilator
- power supply
- system interface
- monitoring/alarms.

Figure 2-2. Narkomed M Back View



The Narkomed M is a mobile unit, easily transported when disassembled and stored in two protective containers.

Packing List

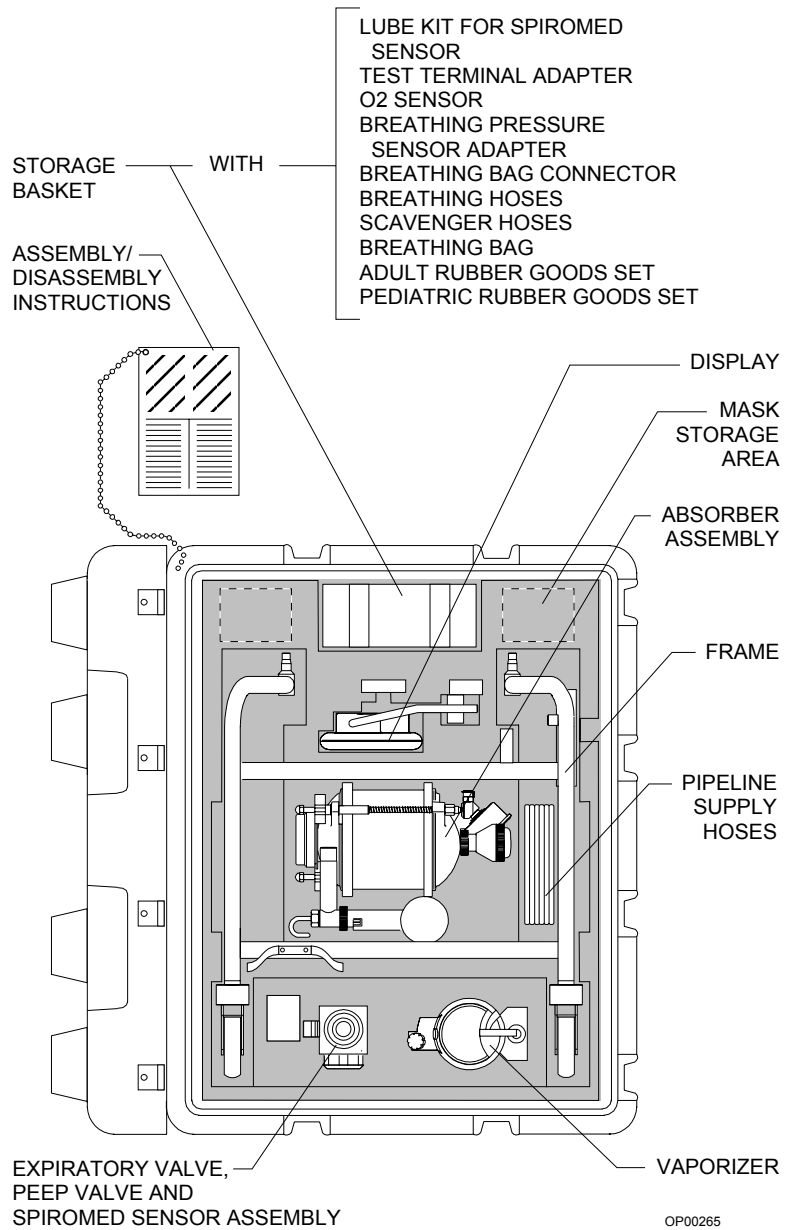
Container 1 contains the:

- support frame
- display and monitor support assembly
- absorber assembly
- expiratory valve, PEEP valve and Spiromed sensor assembly
- vaporizer
- pipeline hose, N₂O, DISS, hand, 10 ft. long
- pipeline hose, air, DISS, hand, 10 ft. long
- pipeline hose, O₂, DISS, hand, 10 ft. long
- face mask, newborn
- face mask, child
- face mask, medium adult
- mesh storage basket
 - lubrication kit for Spiromed sensor
 - test terminal adapter
 - O₂ sensor
 - breathing pressure sensor adapter
 - power cord, 6 ft.
 - power cord adapter, 2 ft.
 - breathing bag connector
 - corrugated hose, 22 mm ends x 22 in. long
 - corrugated hose, 19 mm ends x 20 in. long
 - corrugated hose, 19 mm ends x 30 in. long
 - breathing bag, 3.0-liter, 19 mm
 - rubber goods set, which includes:
 - breathing bag, 2.0-liter, 22 mm
 - two corrugated hoses, 22 mm ends x 32 in. long
 - mask elbow
 - Y-piece
 - pediatric circuit, which includes:
 - breathing bag, 0.5-liter, 22 mm
 - two corrugated hoses, 22 mm x 15 mm x 30 in. long
 - mask elbow
 - Y-piece

Container 2 contains the:

- anesthesia machine
- scavenger with mounting bracket
- Operator's Instruction and Setup Manual (2x)
- Technical Service Manual (2x)

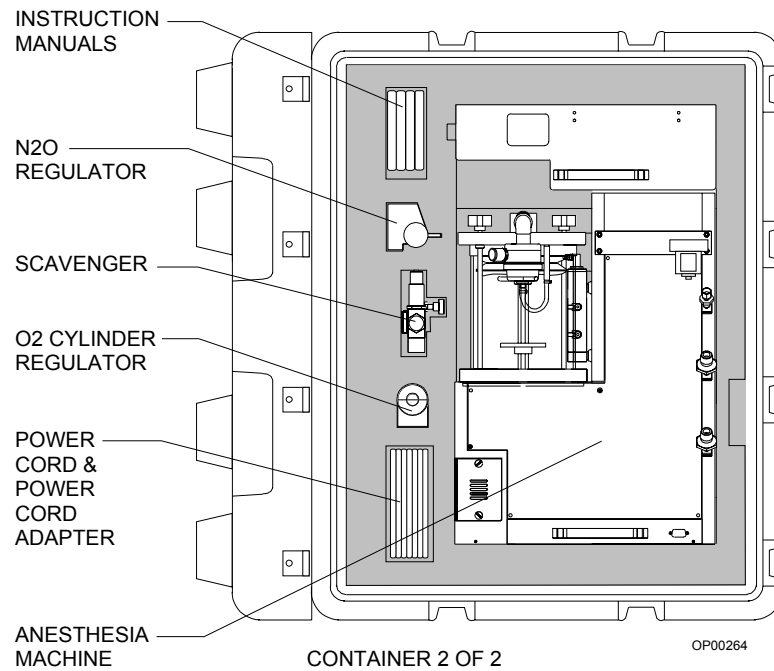
Figure 2-3. Container 1 Contents



OP00265

CONTAINER 1 OF 2

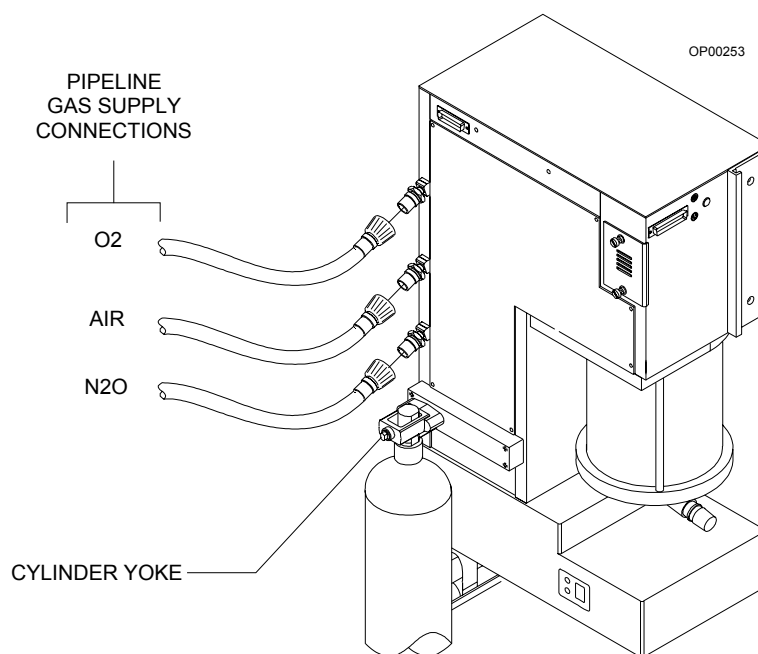
Figure 2-4. Container 2 Contents



Gas Delivery System

The pneumatic system can simultaneously deliver up to three gases and one anesthetic agent. Gas is supplied to the system through pipelines and a cylinder. Pipeline connections for oxygen, air, and nitrous oxide are standard. A gas cylinder yoke is provided for one oxygen cylinder. Pipeline connectors and the gas cylinder yoke are located on the back of the anesthesia machine.

Figure 2-5. Gas Delivery Connections



Piping, Hoses, and Fittings

Color Coding Each connection, valve, gauge, and flowmeter is labeled and color-coded for the appropriate gas, as shown in the table below.

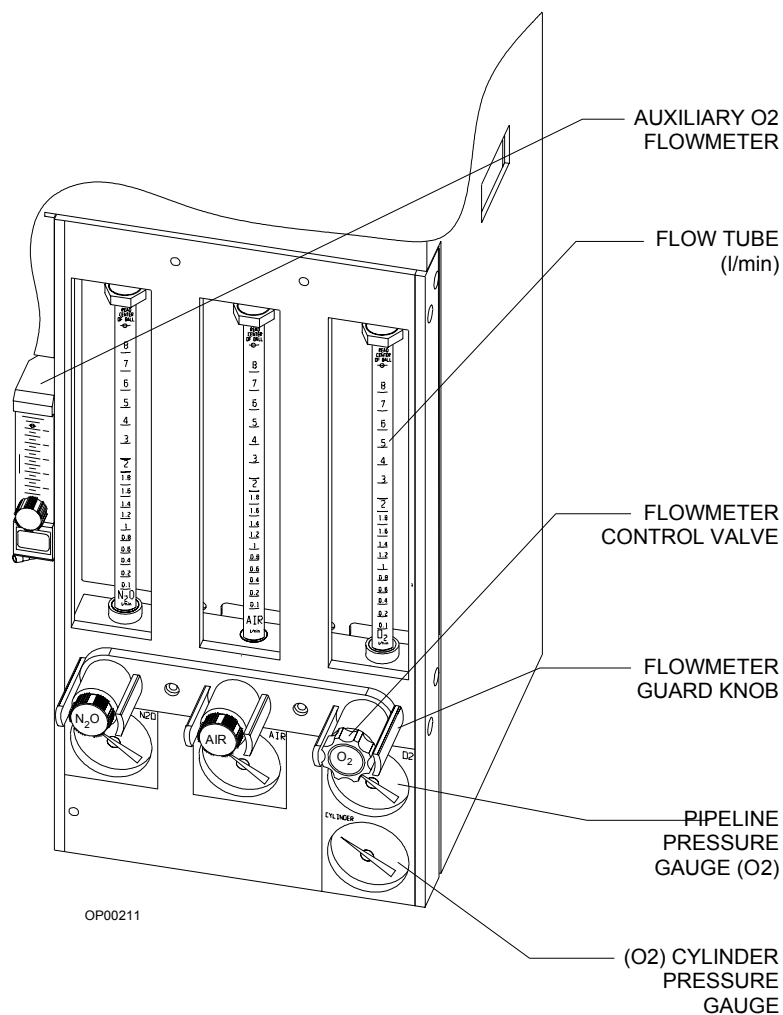
GAS SYSTEM COLOR CODING		
GAS	MARKING	COLOR
Air	AIR	Yellow
Nitrous Oxide	N ₂ O	Blue
Oxygen	O ₂	Green

Pipeline Gas Entry Gas from the pipeline supply enters the system through hoses connected to indexed pipeline inlets. The indexed connector system reduces the risk of delivering the wrong gas to a patient by preventing incorrect connection of gas lines. The inlets have check valves that prevent backflow leakage into the atmosphere when supply hoses are not connected or backflow into the attached supply hoses when the cylinder is used. Each pipeline connection is equipped with a filter to prevent foreign material from entering the internal gas piping. Pipeline gases should be supplied at 50–55 psi.

Gas Supply Hoses Three color-coded gas supply hoses are provided to connect the anesthesia machine to the pipeline gas supplies. The fittings should be hand-tightened. No special tools are needed to attach the hoses to the pipeline inlets. The fittings are also sized so they cannot be connected to the wrong inlet. This system prevents inadvertent cross-connections between the O₂ and N₂O fittings.

Pipeline Pressure Gauges Pipeline pressure gauges for oxygen, air, and nitrous oxide are standard. These gauges are labeled and color-coded for their respective gases on the flowmeter shield. The gauges are located directly below their corresponding flowmeters and flow control valves. Pressure is indicated in psi and kPa. The pressure gauge and flowmeter arrangement is shown in the following figure.

Figure 2-6. Flowmeter and Pressure Gauge Assembly



When the machine is connected to an active pipeline supply, each gauge should indicate 50–55 psi. A deviation from within this range indicates that the pipeline gas supply system is improperly adjusted and can adversely affect operation. A fluctuating pipeline supply pressure, for example, would cause a corresponding fluctuation of the gas flow delivered from that pipeline. An excessively low pipeline

pressure can activate the oxygen cylinder and deplete its contents (if the cylinder valve is left in the open position).

CAUTION: To ensure gas supplies are adequate, pipeline pressure gauges should show steady pressures of 50–55 psi.

Cylinder Gas Entry

The Narkomed M is equipped with one oxygen cylinder hanger yoke. To prevent a cylinder from being improperly connected, the yoke is labeled, color-coded, and keyed for oxygen cylinders using the pin-indexed safety system.

A filter in the yoke prevents foreign material from entering the internal gas piping. A check valve in the yoke prevents leakage into the atmosphere when a cylinder is not mounted on the yoke. If a cylinder is not mounted to the yoke, the attached yoke plug should be placed between the yoke bolt and the yoke's gas inlet.

When attaching a cylinder, make sure that only one washer is installed between the cylinder and the yoke gas inlet. Using multiple washers can compromise the pin-indexed safety system. Be sure to verify the integrity of both index pins when installing a new cylinder.

WARNING: Make sure the cylinder yoke has two intact index pins each time the cylinder is replaced. Use only one cylinder gasket. Using more than one gasket can cause cylinder gas leakage and compromise the pin-indexed safety system.

The cylinder attached to the hanger yoke must contain oxygen at the recommended pressures outlined in the table below. Any cylinder that contains less than the recommended minimum shown in the table should be replaced with a new, full cylinder.

GAS	PSI - FULL	PSI - MIN
Oxygen	1900	1000

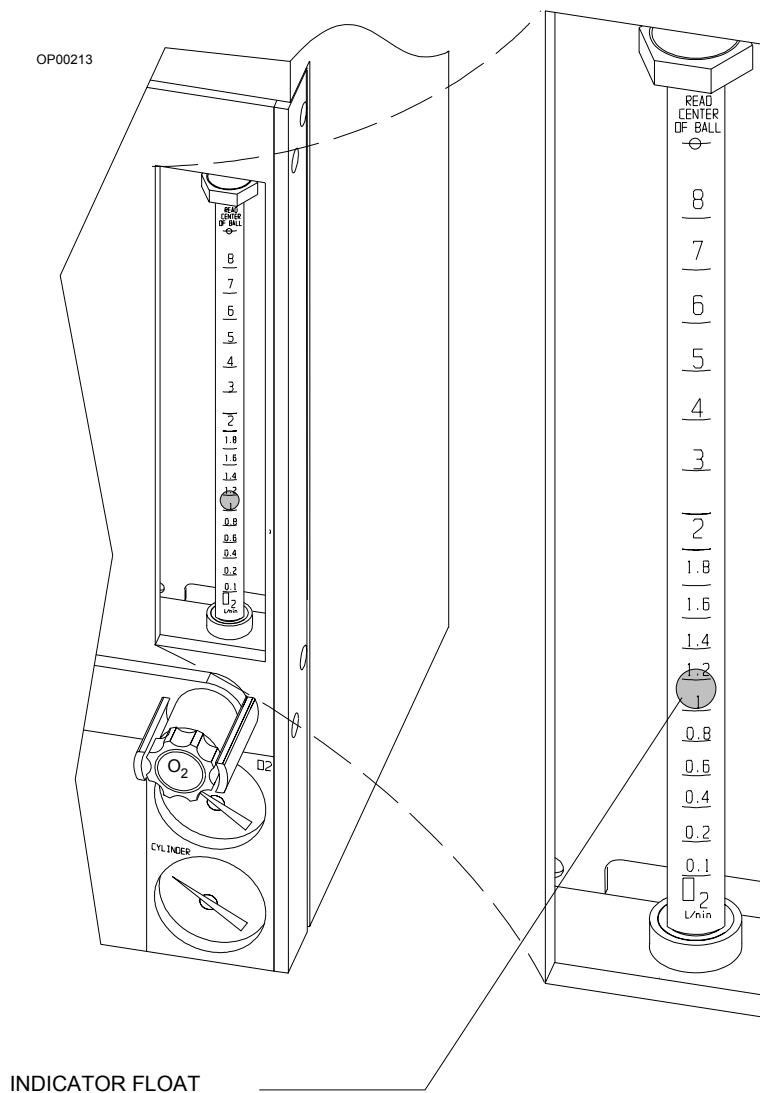
Indicated pressure is for an E-size cylinder at 70°F (21°C).

Cylinder Pressure Gauge

The cylinder gas circuit has a cylinder pressure gauge. The gauge is labeled and color-coded on the flowmeter housing. When the cylinder valve is open, the pressure gauge indicates the gas pressure in the cylinder. Pressure is indicated in psi and kPa. The indicated pressure is proportional to the gas content of the cylinder.

2	General Description
Oxygen Supply Pressure Failure Protection Device	<p>The oxygen failure protection device (OFPD) is a pneumatically operated valve that protects the patient in the event of partial or complete loss of oxygen pressure. The valves are located in the internal supply lines for all gases except oxygen. The gas pressure in the oxygen supply line controls the valves. When the oxygen pressure is adequate, the valves remain open with an unrestricted gas flow. Oxygen pressure loss causes the valves to close proportionally to the loss of pressure. As a result, OFPD-controlled gases can be restricted or shut down in response to loss of oxygen pressure.</p> <p>Gas flow reductions are indicated on the flowmeter. When the oxygen supply from the pipeline or cylinder pressure drops below about 37 psi:</p> <ul style="list-style-type: none"> • an O₂ SUPPLY LOW Caution message appears in the Alarm window on the monitor • an intermittent alarm sounds. <p>NOTE: If only one source of oxygen supply pressure (either the cylinder or pipeline) fails and the other source maintains proper supply pressure in the oxygen supply lines, the OFPD and the alarm are not activated.</p>
Flowmeters	<p>The individual flowmeters for each gas are located directly above their corresponding flow control valves. The flowmeters indicate the delivered flow rate of each gas in the fresh gas mixture. The specific gas is labeled at bottom of the flowtube.</p> <p>Each flowmeter has a float indicator. To determine the flow rate, read the flowmeter scale at the center of the float.</p>

Figure 2-7. Flowmeter and Indicator Float



**Minimum
Oxygen Flow**

The oxygen dispensing system has a calibrated bypass flow of 150 \pm 50 ml/min (at 50 psi pipeline pressure) that delivers this volume of oxygen even if the oxygen flow control valve is fully closed.

Flow Control Valves

A valve located below each flowmeter tube is used to adjust the gas flow. Turning the valve knob counterclockwise increases flow. Turning the knob clockwise decreases flow. A zero-stop prevents damage to the flow control valve seats. If necessary, a qualified technical service representative can readjust the stop.

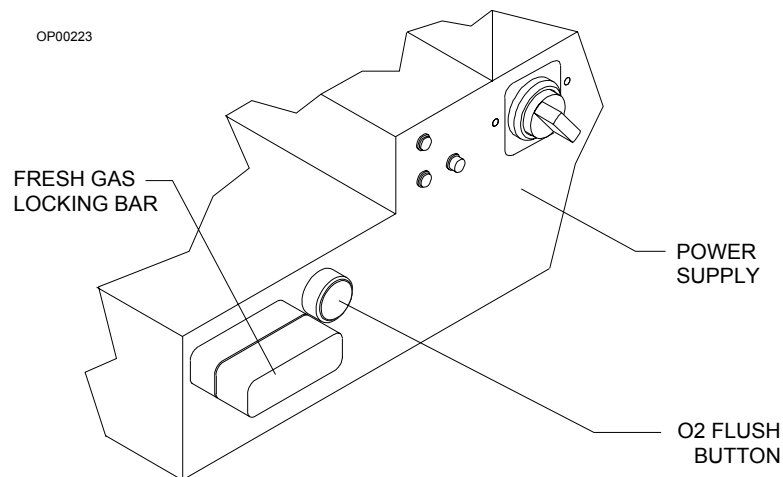
Each flow control knob is identified by its color code and chemical symbol. The oxygen flow control valve is also touch-coded with a deeply fluted knob. Each knob has a guard to prevent accidental adjustment to gas flow.

CAUTION: The oxygen flow cannot be completely shut off. Do not force the oxygen flow control knob in an effort to shut off the minimum flow. Forcing the knob can damage the valve seat.

Oxygen Flush

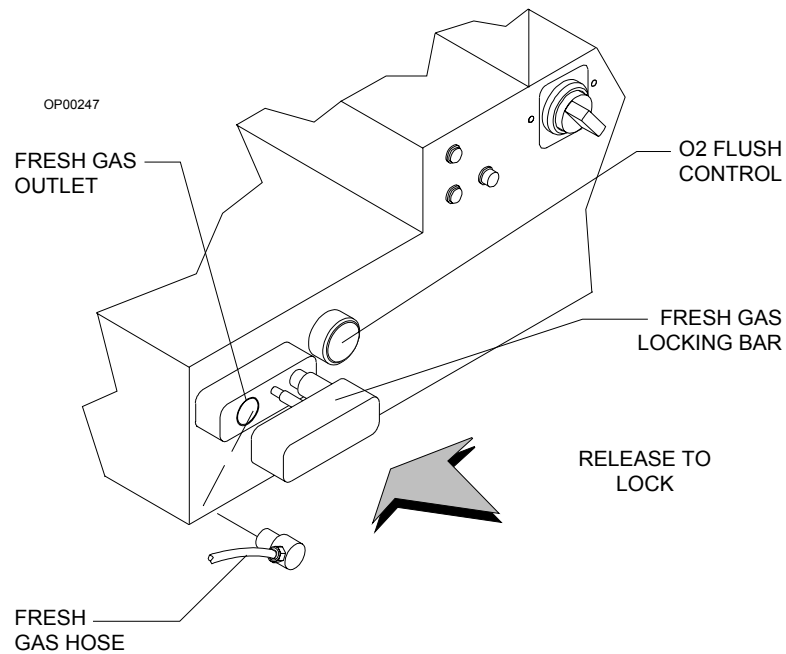
A manually operated, self-closing oxygen flush valve is located on the front of the power supply area of the machine. A bezel is mounted around the push-button to prevent accidental engagement. When pressed, the valve delivers an unmeasured oxygen flow of about 55 l/min directly to the fresh gas common outlet. The SYSTEM POWER switch does not have to be on to use the oxygen flush.

Figure 2-8. Power Supply with O2 Flush Button



	General Description	2
Oxygen Ratio Controller	<p>The Oxygen Ratio Controller (ORC) is a pneumatic oxygen/nitrous oxide interlock system that maintains a fresh gas oxygen concentration of $25 \pm 4\%$. The ORC allows independent control of the oxygen and nitrous oxide flows.</p> <p>The ORC proportionally limits the nitrous oxide flow whenever the selected oxygen and nitrous oxide flow control valve settings would otherwise result in a hypoxic fresh gas mixture.</p> <p>For example, if you open the nitrous oxide flow control valve excessively without making a corresponding increase in the oxygen flow control valve setting, the flow of nitrous oxide will not increase even though its flow control valve setting was greatly increased. Similarly, if you decrease the oxygen flow without also decreasing the nitrous oxide flow, the nitrous oxide flow will automatically drop in proportion to the oxygen flow.</p> <p>WARNING: In circle systems, the gas mixture in the patient circuit is not necessarily the same as that in the fresh gas flow. This is particularly true at low fresh gas flow rates when the patient rebreathes a significant amount of previously exhaled gases. It is important that the gas mixture in the patient circuit is monitored and that the fresh gas flow is adjusted to meet the requirements of the patient and to compensate for patient intake, any system leakage, or any gas drawn through sample lines and not returned.</p>	
Fresh Gas Outlet (15 mm)	<p>The fresh gas outlet (Figure 2-9 on p. 2-14) delivers the fresh gas mixture (consisting of oxygen, nitrous oxide, and air) and vapors of a liquid anesthetic to the patient breathing system. The outlet is located on the front of the anesthesia machine.</p> <p>The 15 mm cylindrical female fitting accepts a 15 mm male fitting on the absorber fresh gas hose. The male fitting slides into a retaining slot in the spring-loaded safety locking bar to prevent inadvertent disconnection of the fresh gas hose. The 15 mm male fitting on the fresh gas hose is unique to Draeger Medical, Inc. design and should not be replaced by a hose from any other manufacturer.</p>	

Figure 2-9. Fresh Gas Outlet



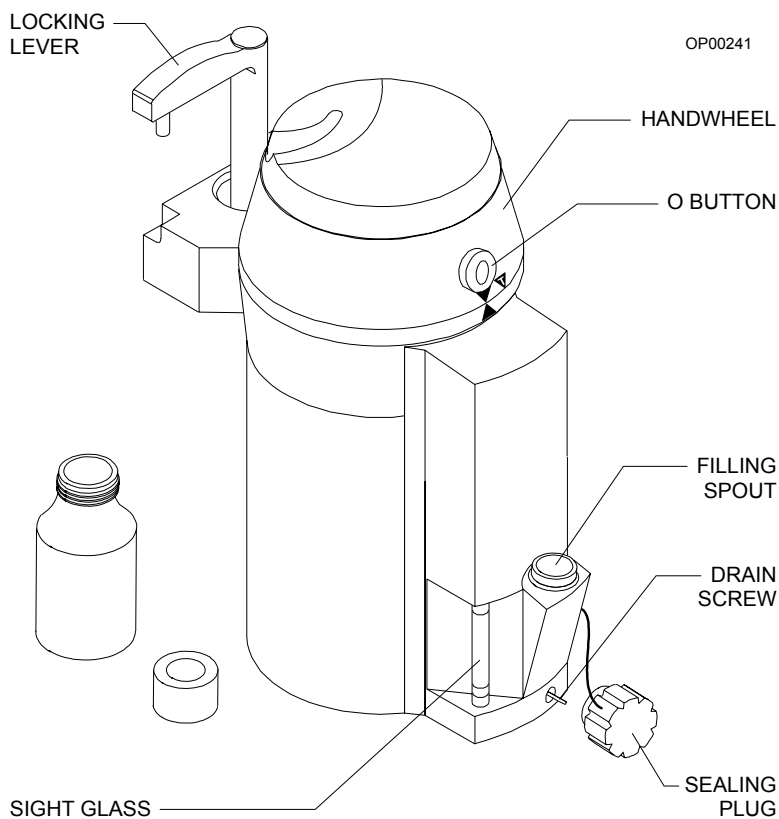
**Auxiliary
Oxygen
Flowmeter**

For the delivery of a metered flow of pure oxygen (for example, delivery of oxygen through a nasal cannula), an auxiliary oxygen flowmeter is mounted on the left side of the flowmeter bank (Figure 2-6 on page 2-8). This flowmeter can be used when the machine is turned off.

Anesthetic Vaporizer

The Narkomed M is equipped with a Dräger-Vapor 2000 vaporizer. This vaporizer enriches fresh gas with precisely metered vapor of liquid anesthetic agent. The vapor is inserted in to the fresh gas line. It is connected between the fresh gas metering unit and the fresh gas outlet.

Figure 2-10. Dräger-Vapor 2000 Vaporizer



WARNING: If the wrong anesthetic is used, the delivered concentration can be higher or lower than the concentration set on the handwheel.

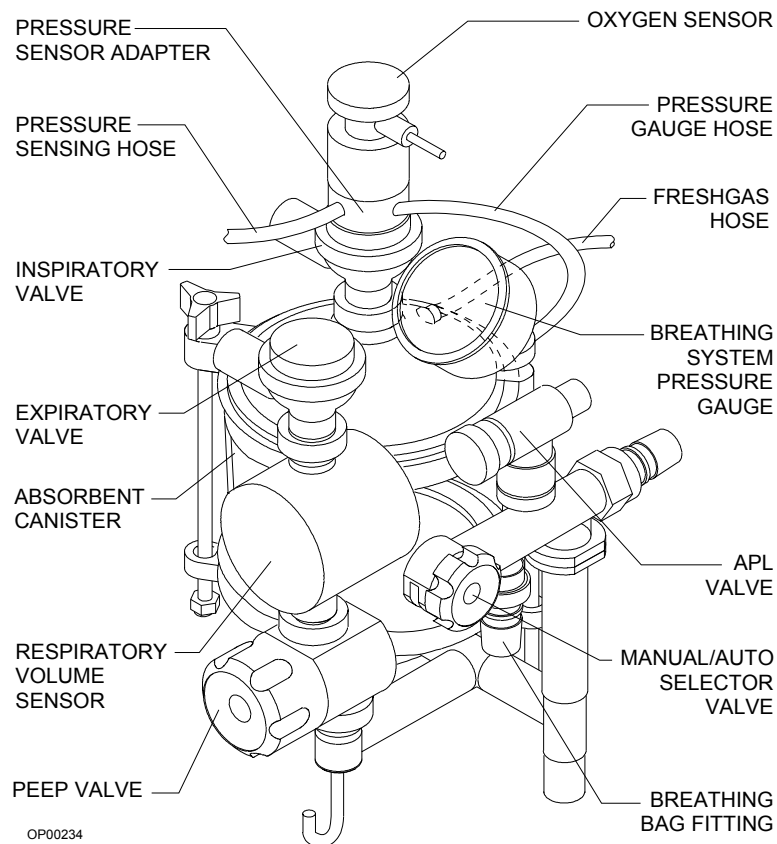
WARNING: Be sure to fill the vaporizer in an upright position. Filling the vaporizer in a tilted position can cause overfilling. Overfilling causes the anesthetic concentration rate to be higher or lower than the handwheel setting.

CAUTION: Handle the vaporizer with care. Do not drop, carry by the handwheel, sealing plugs, or locking lever. Damage to the vaporizer will result.

Absorber System

A single-canister system absorbs exhaled carbon dioxide in the rebreathing circuit of the anesthesia machine.

Figure 2-11. Absorber System



The absorber system is equipped to accommodate sensors to monitor oxygen concentration, tidal volume, respiratory minute volume, and respiratory frequency. The PEEP valve regulates positive end-expiratory pressure in the patient breathing circuit.

The absorber system handles spontaneous, manually assisted, or automatic ventilation. The preferred mode of operation is selected with the manual/automatic selector valve.

WARNING: Waste gas scavenging systems used with Draeger Medical, Inc. absorber systems must have safety features to ensure that excessive subatmospheric pressure (lower than -0.5 cmH₂O) and excessive positive pressure (higher than +5.0 cmH₂O) are not possible at the connection point.

The absorber system includes:

- an inspiratory valve and an expiratory valve
- an absorber canister and dust cup
- a breathing system pressure gauge
- a pressure sensing hose assembly
- fresh gas hose
- manual/automatic (ventilation) selector valve
- an adjustable pressure limiter (APL) valve
- respiratory volume sensor
- oxygen concentration sensor
- a positive end-expiratory pressure (PEEP) valve.

Inspiratory and Expiratory Valves

The inspiratory and expiratory valves control the gas flow direction in the absorber system. The valves are unidirectional, meaning they permit gas flow in one direction only:

- The inspiratory valve allows gas to flow toward the patient only, without backflow to the absorber.
- The expiratory valve allows gas to flow to the absorber only, with no backflow to the patient.

The valves are *not* interchangeable. They must be connected to the correct mounts to ensure proper flow direction through the absorber system. Different size mounting threads on each valve prevent connecting a valve to the wrong vent.

WARNING: Do not use the inspiratory or expiratory valves if:

- a pin in the valve domes or valve body is bent, damaged, or missing
- the valve disks are missing or damaged
- the valve seat is damaged.

The inspiratory valve dome has a port for the pressure sensor hose assembly. The oxygen concentration sensor fits on top of the pressure sensor hose assembly. A cap is tethered to the absorber for plugging into the inspiratory valve dome when the oxygen sensor and pressure sensor hose assembly are not in place.

Canister

The absorber system has a transparent plastic canister that houses the absorbent. The absorbent—soda lime or barium hydroxide lime—is available in either loose, granular form or in a prepacked cartridge.

When using loose absorbent, do not fill above the maximum fill level line located about a quarter-inch from the top of the canister. The clearance and the ratio of canister diameter to screen opening minimize the potential for *channeling*. In channeling, gas flows through the canister along the path of least resistance. The gas depletes the efficiency of the absorbent along this route, bypassing absorbent in other areas of the absorber.

Dust Cup

A removable cup at the bottom of the absorber canister assembly collects absorbent dust and excess moisture that can cause increased flow resistance in the system.

Fresh Gas Hose

The fresh gas hose is connected to the upper absorber dome. This flexible hose delivers fresh gas to the breathing system. It has a 15 mm male fitting designed to fit the Draeger Medical, Inc. fresh gas outlet and must not be replaced by another manufacturer's fitting.

Breathing System Pressure Gauge

The absorber system has a pressure gauge for quick visual readings of breathing circuit pressure. The gauge is marked for measurements from -20 to +80 cmH₂O in increments of 2 cmH₂O. The pressure gauge line is connected to the absorber at the pressure sensing adapter.

WARNING: Frequent observation of the breathing system pressure gauge is mandatory to ensure adequate pressure buildup and relief, regardless of the mode of operation.

General Description		2
Pressure Sensing Hose Assembly	Pressure is monitored at the absorber. A pilot line connects the anesthesia system pressure monitoring and alarm system.	
Manual/Automatic Selector Valve	The manual/automatic selector valve has two-position control knob for selecting gas pathways for automatic or manually assisted ventilation. Turning the knob clockwise sets the system to AUTO. Turning the knob counterclockwise, sets the system to BAG.	
Adjustable Pressure Limiter (APL) Valve	The APL valve relieves excess gas from the breathing circuit into the scavenger system. The APL valve expels excess gas containing expired carbon dioxide before it contacts the absorbent, which extends the life of the absorbent.	
Respiratory Volume Monitor Sensor	The respiratory volume sensor is a spiromed sensor that monitors tidal volume, respiratory minute volume, and respiratory frequency.	
Oxygen Sensor	The oxygen sensor analyzes oxygen concentration in the patient circuit. The sensor mounts in the port at the top of the pressure sensor adapter, which is connected to a port in the inspiratory valve dome. A plug for closing off the port when an oxygen sensor is not in place is tethered on the absorber system. Draeger Medical, Inc. strongly advocates using an oxygen concentration sensor in the patient circuit.	
Positive End-Expiratory Pressure (PEEP) Valve	The PEEP valve regulates the positive end-expiratory pressure in the patient breathing circuit. PEEP is increased by turning the knob clockwise and diminished by turning the knob counterclockwise. The adjustment range is about 2 to 15 cmH ₂ O. The pressure gauge reading includes the PEEP. At higher PEEP levels, the PEEP valve may emit a low frequency sound that has no effect on the valve's or breathing system's performance.	

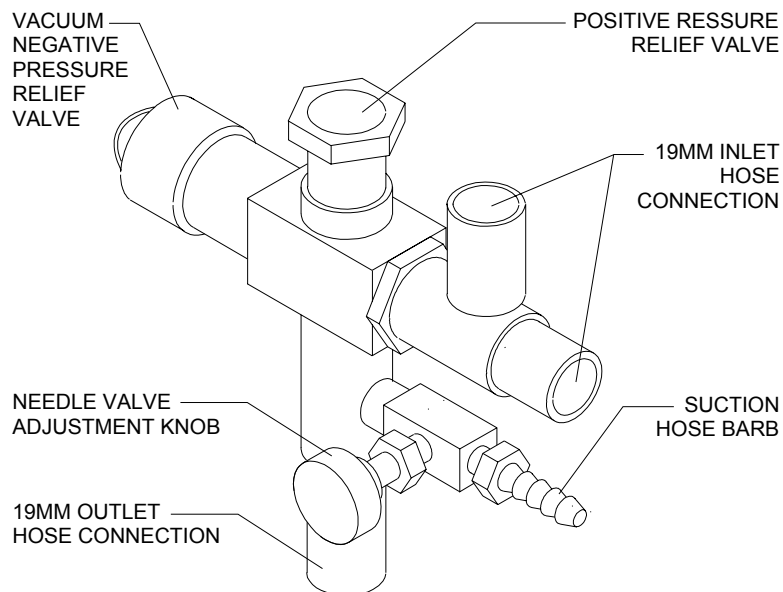
Scavenger System

The scavenger interface is an exhaust collector manifold. It is intended for use with suction (vacuum) or passive waste gas disposal systems.

The suction approach uses continuous suction to transfer the gas from the scavenger to the disposal system. Passive systems rely on the pressure of the waste gas to convey the waste gas to the exhaust system.

This is a closed system that has one spring-loaded valve for positive pressure relief and one for negative pressure relief.

Figure 2-12. Scavenger Interface



OP00228

The exhaust collector manifold has two 19 mm male fittings to connect 19 mm hoses from the ventilator and absorber APL valve to the exhaust system.

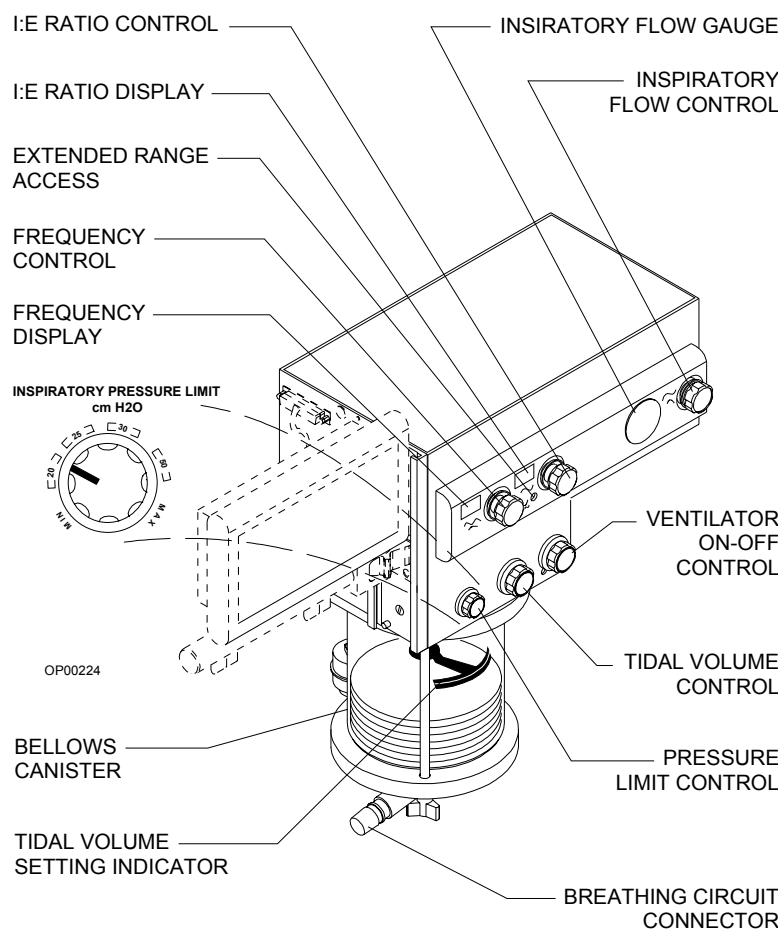
The exhaust collector manifold connects to a suction waste gas disposal system with the hose barb. An adjustable needle valve regulates the waste gas exhaust flow. A 3.0 liter reservoir bag contains the excess waste gas. This system accommodates a variety of waste gas flow rates from the patient breathing system.

A 19 mm hose connects to the fitting below the hose barb for passive exhaust systems. A relief valve guards against excessive pressure build-up if the exhaust hose is restricted.

Anesthesia Ventilator

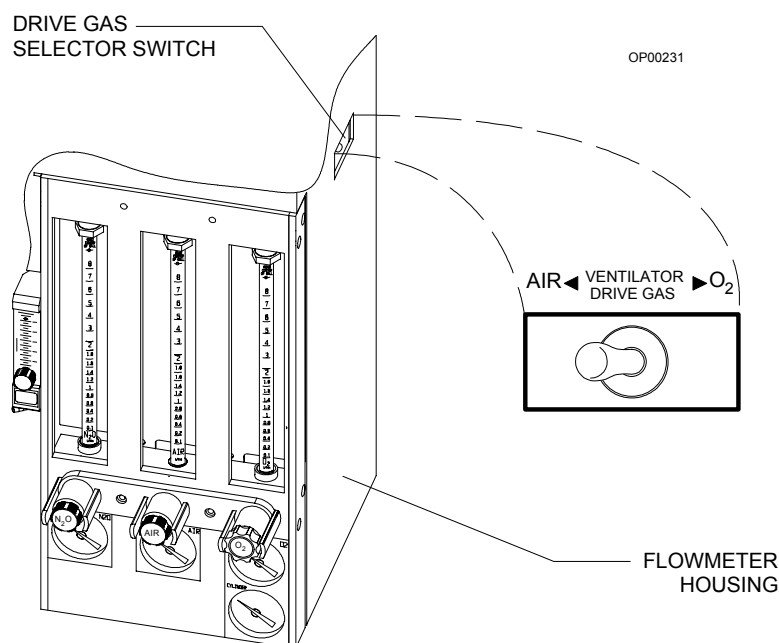
The anesthesia ventilator is a volume-preset, time-cycled, pressure-limited ventilator with electronic timing, pneumatic circuitry and independent controls for frequency, inspiratory-to-expiratory (I:E) ratio, inspiratory flow rate, tidal volume, and inspiratory pressure limiting.

Figure 2-13. Anesthesia Ventilator Assembly



Pneumatic power (bellows drive gas) to the ventilator is supplied through the hospital pipeline supply or through the cylinder. A switch on the right side of the housing is used to select either oxygen or air as the drive gas. The pressure of the supply gas must be between 40 and 60 psi. The ventilator will not function properly if this pressure drops below 32 psi. Electrical power is supplied by the AC power source, or, in event of AC power failure, by the backup battery. A fully charged battery can power the ventilator for at least 90 minutes.

Figure 2-14. Drive Gas Selector Switch



The anesthesia ventilator is designed for use with a Draeger Medical, Inc. absorber with a manual/automatic selector valve. This valve is for selecting either the breathing bag and adjustable pressure limiter (APL) valve for manual ventilation, or the ventilator bellows for automatic ventilation.

During automatic ventilation, the manual/automatic selector valve isolates the absorber's APL valve from the breathing system. To compensate for the continuous introduction of fresh gas into the breathing system, the ventilator has a relief valve mounted behind the bellows chamber.

General Description

2

When the bellows is completely filled, any excess gas in the system is released to the scavenging system through the ventilator relief valve. As in any ascending bellows, the force needed to overcome gravity acting on the bellows causes a positive end-expiratory pressure (PEEP) within the breathing system. For the Narkomed M, the PEEP is approximately 2 cmH₂O.

The pressure limit control is used to set the peak inspiratory pressure produced by the ventilator to prevent barotrauma. The pressure limit control can also improve ventilation for patients with reduced lung compliance (neonatal/pediatric patients and patients with adult respiratory distress syndrome), and can be used to limit the peak inspiratory pressure during the inspiratory phase of ventilation.

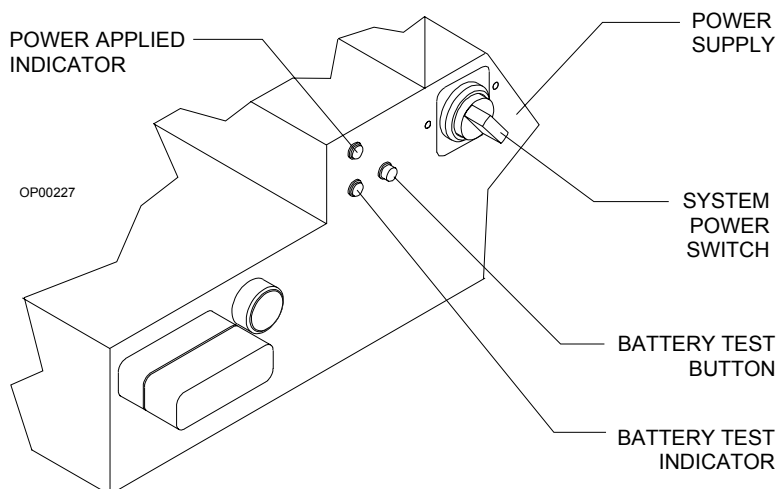
Power Supply System

The Narkomed M has a central power supply for the ventilator, alarm system, and monitoring system. When in use, the Narkomed M must be plugged into an AC outlet.

System Power Switch

The SYSTEM POWER switch is located at the front of the power supply. It has two positions, ON and STANDBY. In the ON position, the gas (pneumatic) and electric power circuits are actuated. In the STANDBY position, the switch shuts down the fresh gas supply, the monitoring system, and all electrical power to the machine except the battery charging circuit. When power is on, the green power on indicator lights.

Figure 2-15. System Power Supply



Circuit Breakers

The electrical system has two magnetic circuit breakers to protect machine functions (primary AC power input and backup battery power). The circuit breakers are located on the lower part of the power supply in the back of the machine.

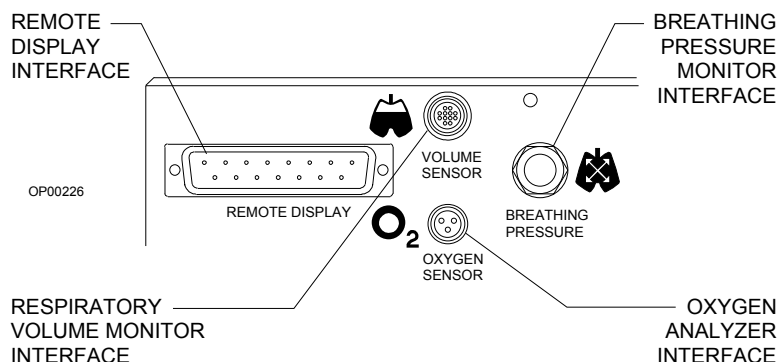
A circuit breaker is in its normal, closed position when the plunger is flush with the surface of its base. A circuit breaker is open (tripped) when its plunger extends beyond its base. If a breaker is tripped, the cause must be found and corrected before using the anesthesia system.

General Description		2
Backup Battery System	<p>The backup battery system consists of a rechargeable battery and a built-in battery charging system.</p> <p>The backup battery system automatically provides power with no delay during the period between line power failure and activation of an emergency generator during a power outage. It also provides power if the cord is accidentally unplugged during a case. The system automatically switches back to AC power and recharges its battery when power is restored.</p> <p>The battery charging system charges the battery any time the power cord is connected to an active AC power source. The charger can recharge a fully discharged battery in about 12 hours.</p> <p>If the machine is getting AC power, but the battery voltage level is low due to a problem with the battery charging circuit or similar hardware malfunction, the Advisory message RESERVE BATT LOW is displayed.</p>	
Machine Functions on Backup Battery Power	<p>These events signal backup battery system activation:</p> <ul style="list-style-type: none"> • The Caution message AC POWER FAIL is displayed. • A three-pulse pattern audio alarm sounds every 30 seconds. <p>These alarms signify that about 90 minutes of backup battery power remains from the time the alarm is activated if the battery was fully charged. All monitoring functions continue to operate, using the battery for power.</p> <p>When the battery reserve approaches depletion after an AC power loss, the Caution message AC BATTERY FAIL is displayed.</p> <p>This alarm signifies that about 10 minutes of backup battery power remains from the time the message is activated.</p> <p>The gas supply system remains operative. Because the ventilator is inoperative when battery power is cut off, you must perform manual ventilation by bag. The machine cannot provide monitoring or alarm functions until AC power is restored.</p> <p>NOTE: If the power cord is not plugged into an active AC outlet for a period of 30 days or more, the backup battery can become depleted. Plugging the power cord into an active AC outlet for about 12 hours will recharge a depleted battery.</p>	
Battery Test Indicator and Button	<p>The battery test button and indicator located on the power supply are used to determine the backup battery status (Figure 2-15 on page -24). A detailed testing procedure is included in the checkout procedures in this manual.</p>	

System Interface Panel

The system interface panel has receptacles for the remote display, oxygen sensor cord, the breathing pressure pilot line, and the respiratory volume sensor cord. The panel is located on the display side of the anesthesia machine near the top of the housing.

Figure 2-16. System Interface Receptacles



Remote Display and Support Arm

The remote display (monitor screen and controls) is mounted on the absorber side of the machine. The display can be adjusted up or down to place it in the most convenient position. The support arm below the monitor screen supports an external patient monitor.

Monitoring System

The monitoring system integrates the functions of the electronic monitors and organizes information from these monitors on the monitor screen.

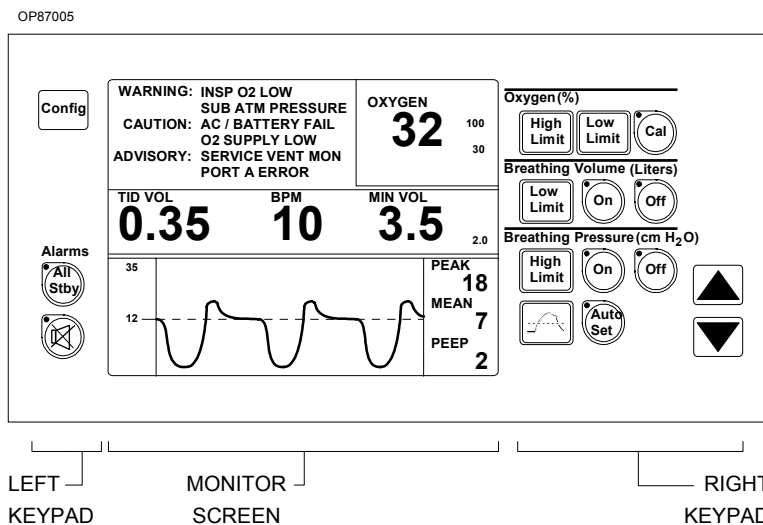
The Narkomed M monitors:

- oxygen concentration measurements
- breathing pressure measurements
- respiratory volume measurements
- oxygen supply pressure
- backup battery status.

Monitor Screen and Controls

All monitoring data and alarm messages are displayed on the monitor screen. Use the control keys on either side of the screen to establish monitoring settings. With the left keypad, you can control system-wide settings, such as alarm annunciation and monitor configuration. With the right keypad, you can control settings for specific monitors oxygen concentration, breathing pressure, and respiratory volume.

Figure 2-17. Monitor Screen and Controls



Alarm System

Alarms are organized into three categories, depending on the urgency of the alarm condition.

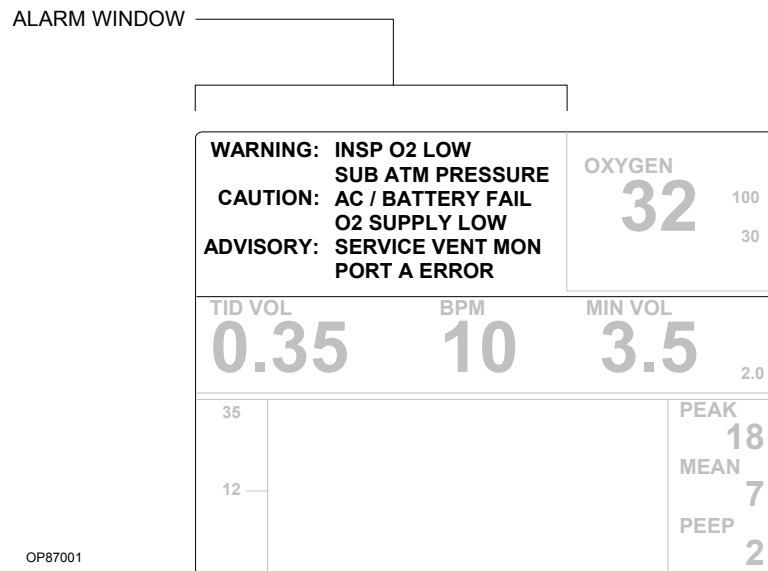
Warnings	The highest priority alarms requiring an immediate response
Cautions	Second priority alarms requiring a prompt response
Advisories	The lowest priority alarms requiring the operator's awareness

Visual and audible notification announce the most urgent conditions.

Alarm Display

Messages for active alarm conditions appear in the Alarm window at the top of the monitor screen. Messages are displayed for up to six of the highest priority active alarm conditions. Any additional lower priority active alarm conditions are retained in the monitor's memory. Messages for these lower priority conditions are displayed when the higher priority alarm conditions are resolved and their messages are removed from the display.

Figure 2-18. Alarm Window Display



General Description

2

Alarm Annunciation

Each alarm category has a specific audible signal:.

Warnings

A three-pulse tone pattern that is initially repeated every few seconds in a series of descending volumes, and then constantly at full volume until the alarm condition is resolved

Cautions

A three-pulse tone pattern that is repeated every 30 seconds

Advisories

A single tone or no sound at all, depending on the urgency of the advisory

The alarm sounds only for the highest-priority, currently active alarm condition. Tones for lower priority alarm conditions are temporarily suppressed eliminate simultaneous alarms. If the primary speaker fails, the Advisory message SERVICE SPEAKER appears in the Alarm window.

Ventilation Alarms

When the system power switch is turned ON, the volume and pressure apnea alarms default to Standby to allow machine setup without sounding alarms. An interlock with the ventilator ensures that when the ventilator is turned on, the alarms are enabled. You can also enable the alarms individually using the keypad.

When the ventilator is turned off:

If the pressure apnea threshold was greater than 15 cmH₂O when the ventilator was turned off, the threshold setting is changed to 15 cmH₂O. (If the pressure apnea threshold was less than 15 cmH₂O when the ventilator was turned off, the threshold retains its setting.)

The Cautions and Warnings associated with apnea alarms change from activation after 15 and 30 seconds of apnea to 30 and 60 seconds, respectively.

When the ventilator is turned back on, the pressure apnea threshold is restored to its previous set value and the apnea alarms revert to activation after 15 seconds (Caution) and 30 seconds (Warning) of apnea.

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Specifications

General

Anesthesia machine dimensions (approx.) (W x H x D)	16 x 51 x 21 inches
Anesthesia machine weight (assembled) (approx.)	141 lbs
Container 1 dimensions (W x H x D)	30 x 16 x 20 inches
Container 1 weight (packed)	102 lbs
Container 2 dimensions (W x H x D)	26½ x 19 x 24 inches
Container 2 weight (packed)	105 lbs

Environmental

Storage	Temperature	-20 to 60° C
	Humidity	10–90% relative humidity (noncondensing)
	Barometric Pressure	787 to 523 mmHg
Operating	Temperature	10 to 35° C
	Humidity	30–70% relative humidity (noncondensing)
	Barometric Pressure	787 to 523 mmHg

Electrical

	Equipment class	UL 2601 Class 1, Type B, continuous operation, IPXO
	Leakage current.	≤ 300 microamps (UL 2601)
	Ground impedance	≤ 0.1 ohm (60 Hz source)
	Dielectric withstand	≥ 1500 VAC (UL 2601)
	Chassis resistance (between any metallic point and ground pin on power cord)	≤ 0.1 ohm
117 Volt Power Supply	Primary input voltage (acceptable range)	100 to 240 VAC @ 50/60 Hz
	Primary input current	≤ 2.5 amps @ 50/60 Hz
Backup Battery	Type	Sealed Lead Acid, 12 VDC, 3.4 Ah
	Charging time.	≤ 12 hours
	Reserve power time (from full charge)	≥ 90 min

Gas Delivery System

Pipeline inlet connections	DISS/male (ANSI B57.1-1977)
Pipeline inlet pressure	50–55 psi (345–380 kPa) (O ₂ , N ₂ O, Air)

Specifications

Pipeline gauge accuracy	±3 psi (0–25 psi) ±2 psi (25–75 psi) ±3 psi (75–100 psi)
Cylinder connection	Pin-indexed hanger yoke (ANSI/CGA V-1-1987)
Over pressure relief valve	95 psi (655 kPa)
Fresh gas common outlet	15 mm female
Fresh gas oxygen concentration (ORC)	25 ±4%
Oxygen flush flow rate	55 (±10) L/min
Minimum oxygen flow (at 50 psi pipeline pressure)	150 ±50 mL/min
Low oxygen supply pressure alarm	34–40 psi
Cylinder gauge accuracy	±90 psi (0–750 psi) ±60 psi (750–2250 psi) ±90 psi (2250–3000 psi)

Cylinder Gas Pressure

Oxygen 1900 psi (13100 kPa) E-size cylinder (at 70° F, 21° C)

Flowmeter Accuracy (at 20°C and 760 mmHg)

Oxygen, Nitrous Oxide, Air	
Dual Tapered 0-8 L/min	0.1 to 0.2 L/min ± 50 mL/min 0.2 to 1.0 L/min ±100 mL/min 1.0 to 8.0 L/min ±5% FS
Oxygen (Auxiliary Oxygen)	0–10 L/min ±5% FS

Vaporizer (Dräger-Vapor 2000)

Temperature Range	10–40° C (at normal atmospheric pressure of 760 mmHg)
Flow Range	0.25-15 L/min
Maximum Pressure Load	150 mmHg (above atmospheric)
Maximum Angle of Inclination	30° during operation unlimited during transport (handwheel set to T)
Weight	Approximately 8.4 kg

The following values refer to individual concentration settings when operated with a continuous flow of air, temperature at 22° C, and normal atmospheric pressure (760 mmHg).

Isoflurane

Adjustment range	0.2–6 vol%
Accuracy at a flow of 0.25-10 L/min	± 0.20% concentration (volume) or ± 20% rel. (whichever is higher)
Accuracy at a flow of 10-15 L/min	+0.30/-0.20 concentration (volume) or +25%/-20% rel. (whichever is higher)

Specifications		3
Halothane	Adjustment range 0.2–6 vol% Accuracy at a flow of 0.25-10 L/min . . . $\pm 0.20\%$ concentration (volume) or $\pm 20\%$ rel. (whichever is higher) Accuracy at a flow of 10-15 L/min . . . +0.30/-0.20 concentration (volume) or +25%/-20% rel. (whichever is higher)	
Enflurane	Adjustment range 0.2–8 vol% Accuracy at a flow of 0.25-10 L/min . . . $\pm 0.25\%$ concentration (volume) or $\pm 20\%$ rel. (whichever is higher) Accuracy at a flow of 10-15 L/min . . . +0.35/-0.25 concentration (volume) or +30%/-20% rel. (whichever is higher)	
Sevoflurane	Adjustment range 0.2–8 vol% Accuracy at a flow of 0.25-10 L/min . . . $\pm 0.25\%$ concentration (volume) or $\pm 20\%$ rel. (whichever is higher) Accuracy at a flow of 10-15 L/min . . . +0.35/-0.25 concentration (volume) or +30%/-20% rel. (whichever is higher)	
Ventilator	Frequency 1–99, ± 1 BPM (in 1 BPM increments) I:E ratio <i>Standard range:</i> 1:1–1:4.5, ± 0.1 (in increments of 0.5); <i>Extended range:</i> 4:1, 3:1, 2:1 Inspiratory flow 10–100 L/min (uncalibrated) Tidal volume 50–1500 mL, ± 100 mL Pressure limit control adjustment range 15–120 cmH ₂ O	
Absorber System		
Inspiratory Valve	Mounting ring nut size M35 x 1 Hose terminal 22 mm male	
Expiratory Valve	Mounting ring nut size M33 x 1 Hose terminal 22 mm male	
PEEP Valve	Range approx. 2–15 cmH ₂ O (continuously adjustable)	
Breathing System Pressure Gauge	Range -20 to +80 cmH ₂ O Smallest scale division 2 cmH ₂ O Nominal accuracy -20 to +5 cmH ₂ O: 3% FS +5 to +55 cmH ₂ O: 2% FS +55 to +80 cmH ₂ O: 3% FS Mounting ring nut size 1 1/8 x 18 APL Valve Nominal low flow resistance 2 cmH ₂ O at 8 L/min	

Hose terminal 19 mm male
Breathing Bag TerminalBag terminal 22 mm male

Oxygen Monitoring

Range 10–100 vol % O₂
Resolution 1 vol % O₂
Accuracy ± 3 vol % O₂
(When calibrated within 18 hours, and
constant temperature and pressure)
Response time ≤ 25 sec (T90)Zero drift_ 0.1 vol % O₂/month
Span drift ≤ 1 vol % O₂/8 hours
Temperature error $\leq \pm 3\%$ of reading (15° to 40° C)
Sensor service life ≥ 8 months at 25° C,
50% relative humidity, 50% O₂
gas mixture (or $\geq 5000\%$ hour CO₂)

Breathing Pressure Monitoring

Numeric display range -10 to 125 cmH₂O
Resolution 1 cmH₂O
Accuracy ± 3 cmH₂O or $\pm 10\%$ of reading,
whichever is greater
Waveform display range - full 0–100 cmH₂O
Waveform resolution 1 cmH₂O
Waveform accuracy ± 3 cmH₂O or $\pm 10\%$ of reading,
whichever is greater
Waveform display scales 0–20, 0–50, 0–100 cmH₂O

Respiratory Volume Monitoring

Minute Volume Display Range 0.2 to 50.0 L
Resolution 0.1 L
Accuracy $\leq +10\%$ or 0.1 L, whichever is greater

Tidal Volume Display Range 0.05 to 20.1 L
NOTE: The standard bellows will deliver up to 1.5 L
Resolution 0.01 L
Accuracy $\leq \pm 10\%$ or 0.01 L, whichever is greater
Volume Apnea Threshold 0.05 L

Respiratory Rate Numeric display range 2–99 BPM
Resolution 1 BPM
Accuracy $\leq \pm 10\%$ or ± 1 BPM, whichever is greater

Serial Interface

Serial Ports	Type	RS-232/422
	Baud Rate	300 to 38400
	Parity	Odd, Even, or None
	Data Bits	7 or 8
	Stop Bits	1 or 2
	Protocols	Vitalink

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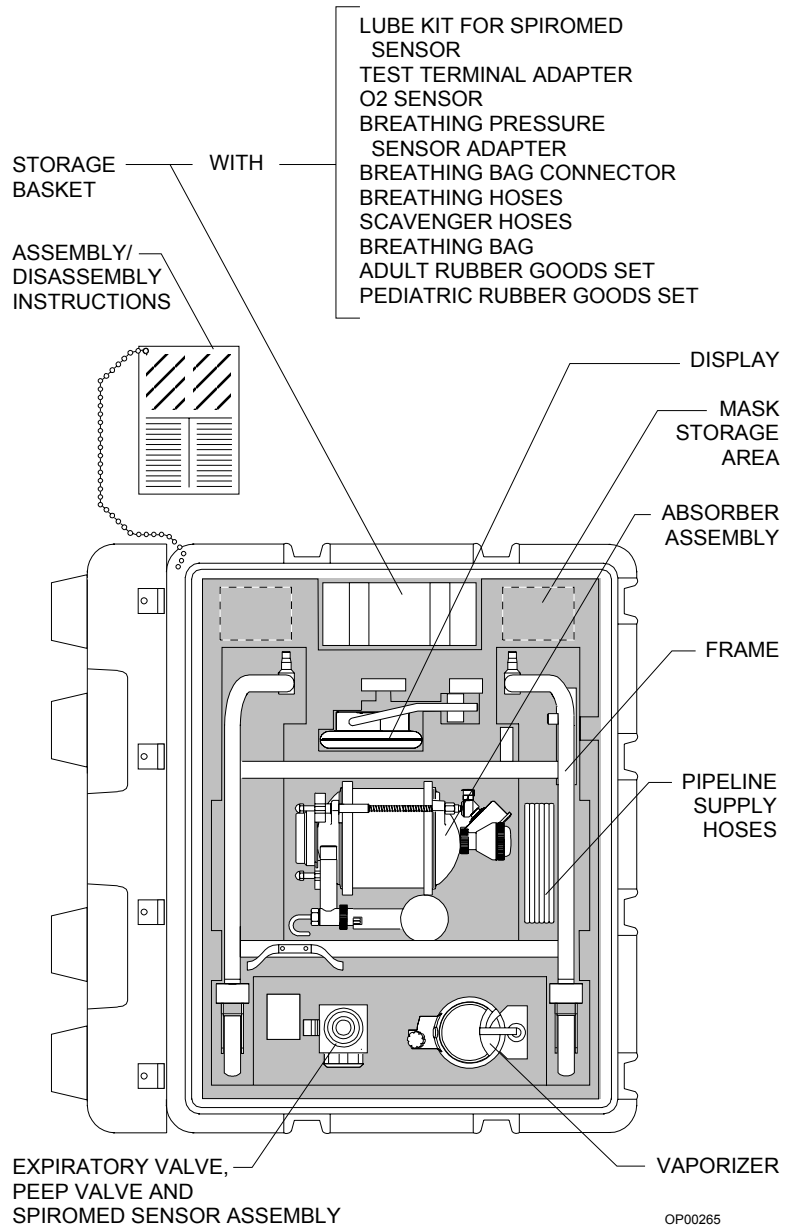
Unpacking, Moving, and Storage

Unpacking the Narkomed M

The Narkomed M is stored in two containers. These containers are joined by latches with half-turn handles. The bottom container houses the anesthesia machine and several accessories. The top container houses the support frame for the machine and the balance of the accessories.

1. Open the latches joining the two containers ($\frac{1}{2}$ turn counterclockwise). Separate the containers and lay them flat on the ground.

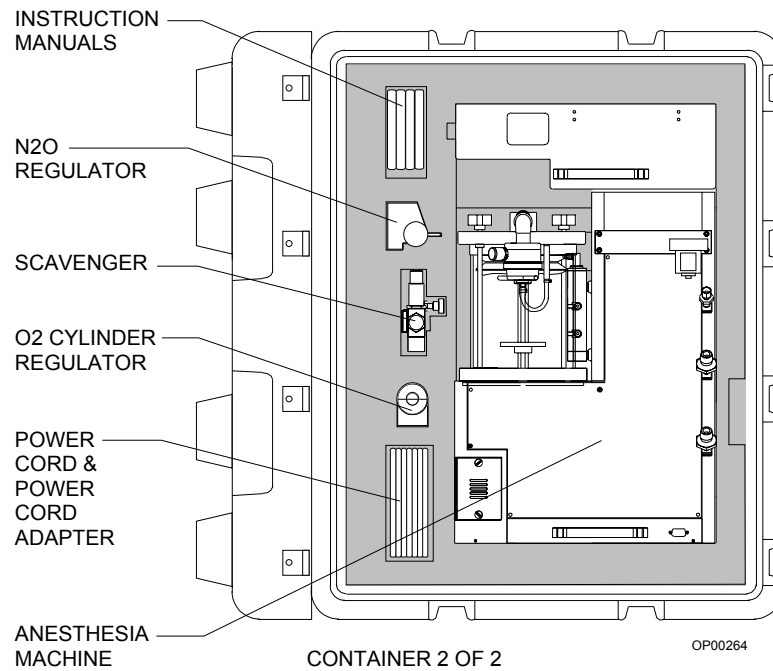
Figure 4-1. Contents of Container 1



OP00265

CONTAINER 1 OF 2

Figure 4-2. Contents of Container 2

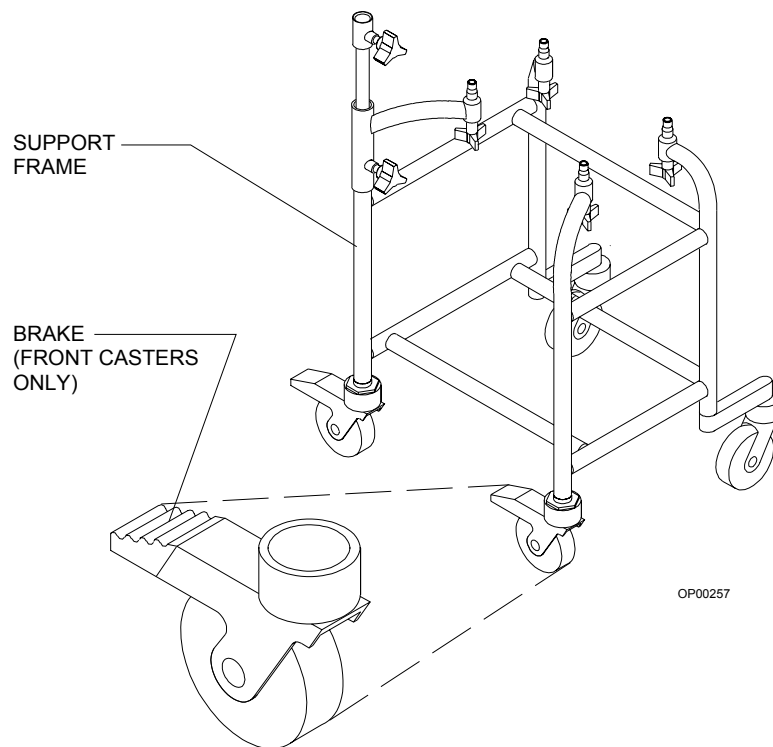


Setup

Setting Up the Support Frame

2. Press the pressure relief button located on the side of Container 1.
3. Open the lid by releasing the latches (½ turn counterclockwise).
4. Unpack the support frame.
5. Swing the rear caster extensions outward and allow them to lock into position.
6. Place the support frame with its casters on the floor.
7. The two front casters are equipped with brakes. Before proceeding to the next step, make sure these casters are locked by stepping on the outboard end of each locking tab.

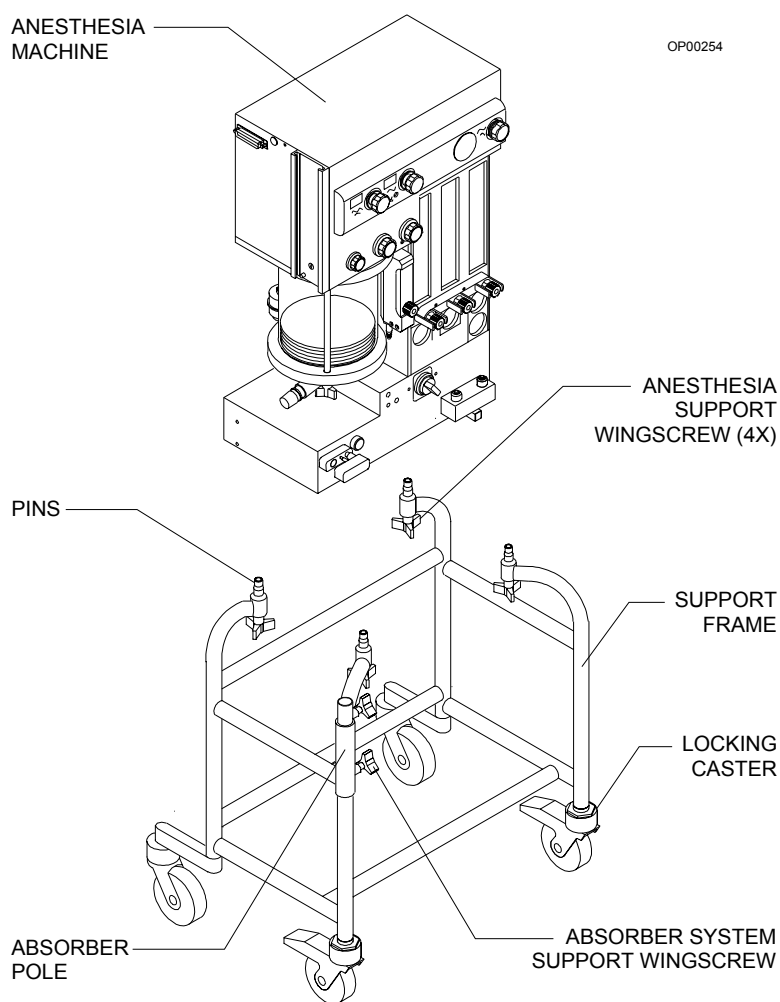
Figure 4-3. Support Frame with Front Locking Casters



**Setting Up
the
Anesthesia
Machine**

8. Press the pressure relief button located on the side of Container 2.
9. Open the lid by releasing the latches ($\frac{1}{2}$ turn counterclockwise).
10. Carefully remove the anesthesia machine from its container by lifting it with the handles.
11. Position the machine with the absorber pole at the left front corner and the locking casters at the front of the machine.

Figure 4-4. Attaching the Anesthesia Machine to the Support Frame



12. Carefully set the machine on the support frame.
13. Tighten the wing screws at the underside of each corner to lock the machine to the support frame.
14. Install the accessories as outlined in the “Setup and Installation” section of this manual.

Moving the Narkomed M

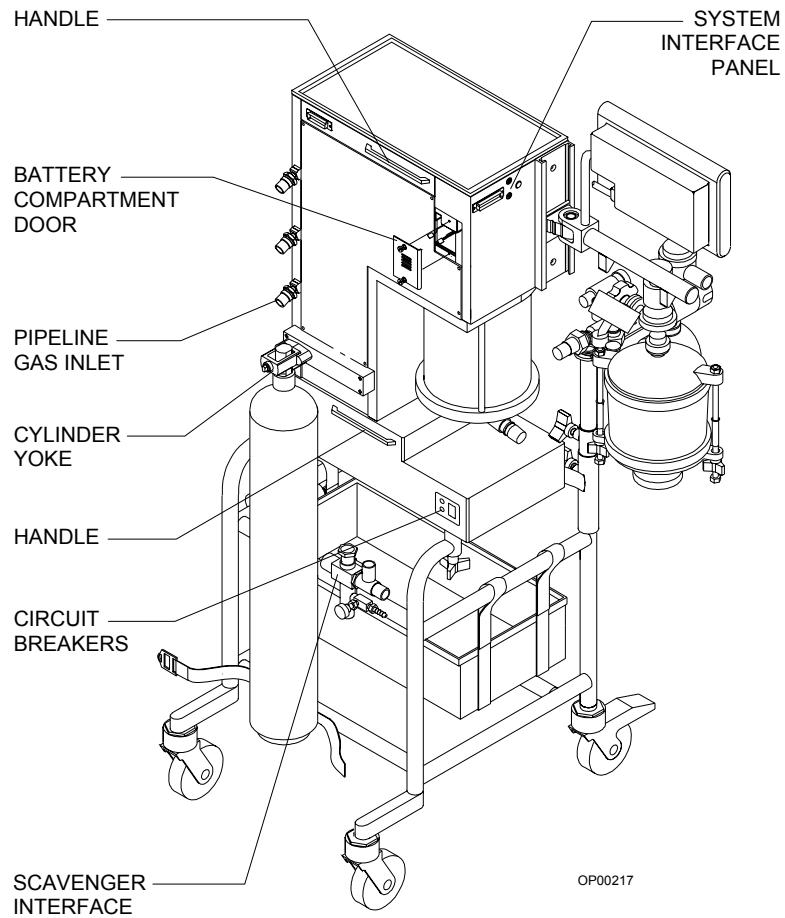
The Narkomed M has two locking casters on the front of the machine. To unlock the casters, step on the lock mechanism on top of the caster. Do not attempt to move the anesthesia machine while the casters are locked. Do not push or pull the anesthesia machine using the absorber system, vaporizers, ventilator bellows, or boom arm.

Observe the following precautions when moving the Narkomed M:

- unplug the power cord,
- remove the vaporizer,
- remove items from the shelf and the display arm,
- secure the absorber against the left side of the Narkomed M, and
- use only the handles shown in the following illustration.

WARNING: When moving the anesthesia machine, remove all monitors and equipment from the top shelf, remove the absorber system, and use only the machine handles to push or pull the unit. The anesthesia machine should only be moved by people who are physically capable of handling its weight. Draeger Medical, Inc. recommends that two people move the anesthesia machine to aid in maneuverability. Exercise special care so that the machine does not tip when moving up or down inclines, around corners, and across thresholds (for example, in door frames and elevators). Do not attempt to pull the machine over any hoses, cords, or other obstacles on the floor.

Figure 4-5. Narkomed M Push/Pull Handles



Storing the Narkomed M

This procedure for disassembling and storing the Narkomed M include instructions for draining the vaporizer, cleaning, and sterilizing the system for long-term storage. Refer to the instruction cards provided in the container for disassembling and storage for transit situations.

WARNING: Always set the vaporizer to 0 before turning off the gas flow to flush vapors from the gas lines.
Uncontrolled inhalation of vapors is a health risk.
Damage to the machine because of vapor leakage can also result.

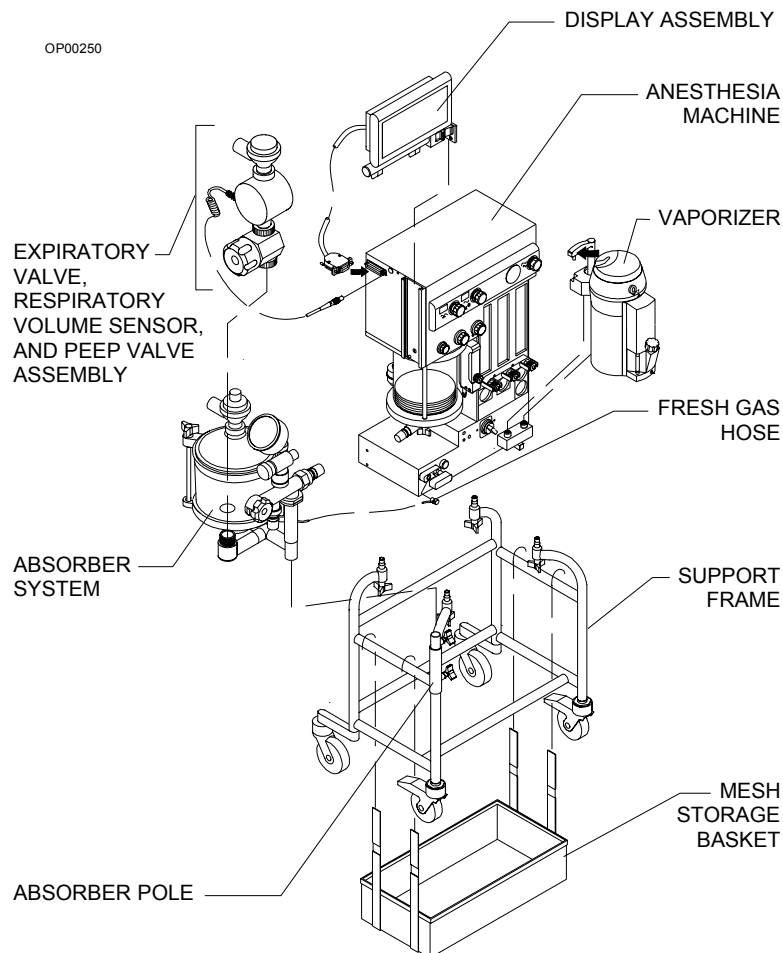
1. Turn the System Power switch to STANDBY.
2. Disconnect, remove, and pack the AC power cord in Container 2.
3. Disconnect, coil, and pack the three gas pipeline hoses in Container 1.
4. Close the cylinder valve, press the O₂ flush to depressurize the cylinder connection, and remove the cylinder from the yoke.
5. Swing the hinged cylinder yoke up, insert the yoke plug, and tighten the yoke bolt down with the cylinder wrench.

NOTE: Follow the instructions in the “Cleaning and Routine Maintenance” section of this manual for cleaning the scavenger, hoses, rubber goods, and the absorber system before storing them.

6. If a passive scavenger system was used, disconnect the exhaust system hose from the scavenger. If a suction scavenger system was used, disconnect the suction hose, remove the bag from the scavenger, clean it, and pack it in the mesh storage basket. Disconnect the scavenger interface and pack it in Container 2.
7. Remove the external patient monitor (if any) attached to the monitor support arm.
8. Disconnect and remove the display assembly and pack it in Container 2.

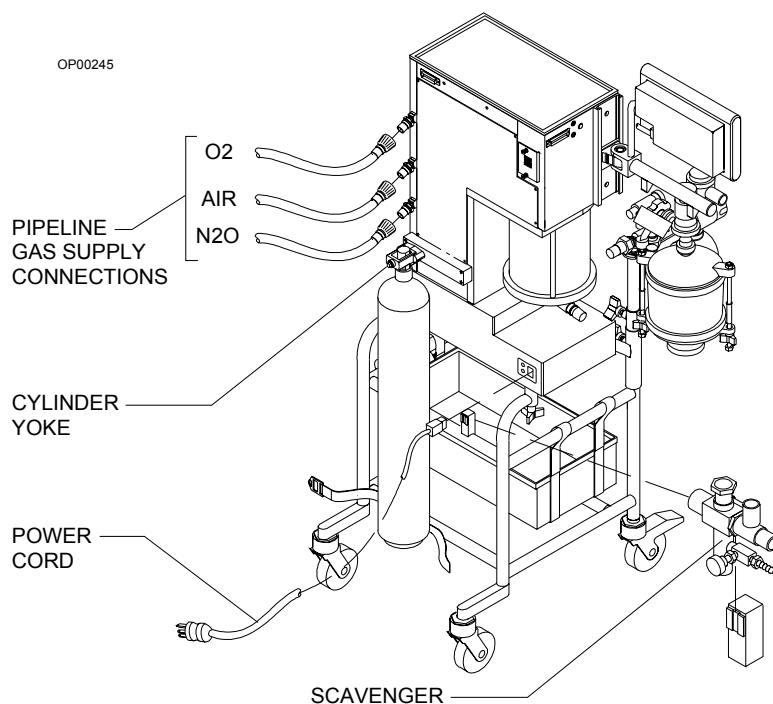
9. Disconnect the breathing circuit hoses from the inspiratory and expiratory valves. Remove the Y-piece, masks, and any other accessories from the hoses. Clean and sterilize these accessories before packing them in the mesh storage basket.

Figure 4-6. Exploded Front View



10. Disconnect the oxygen sensor and pressure sensor adapter from the system interface panel and install the inspiratory valve dome plug.
11. Remove, clean and sterilize the O₂ sensor and pack it in the mesh storage basket.

Figure 4-7. Exploded Back View



12. Remove, clean and sterilize the pressure sensor adapter and pack it in the mesh storage basket.
13. Disconnect the respiratory volume sensor from the system interface panel.
14. Remove the expiratory valve, PEEP valve, and respiratory volume sensor assembly. Clean, sterilize, and pack the assembly in Container 1.
15. Disconnect the fresh gas hose from the fresh gas outlet.

16. Remove the absorbent from the absorber canister. Refer to [“Routine Maintenance and Cleaning”](#) for detailed instructions.

WARNING: Absorbent is caustic and a strong irritant to the eyes, skin, and respiratory tract. When replacing the absorbent, take care not to spill its caustic contents.

17. Remove the absorber assembly. Clean and sterilize the absorber assembly. Pack in Container 1.

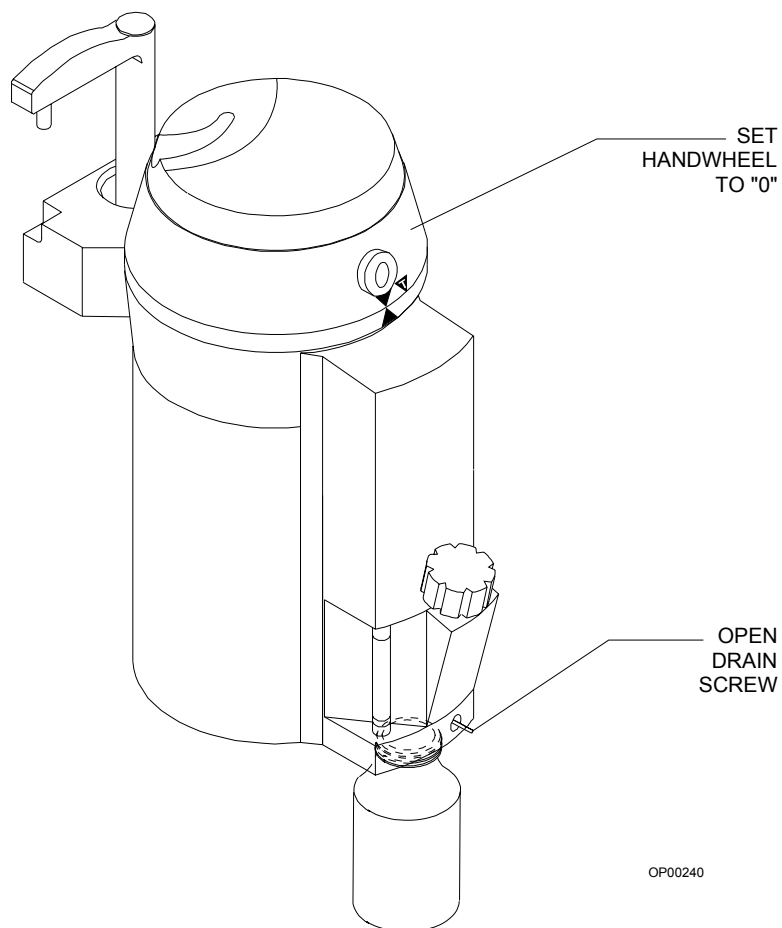
18. Drain the vaporizer. This procedure assumes that the operator is thoroughly familiar with the information provided in the *Dräger-Vapor 2000 Anesthetic Vaporizer Instructions for Use*. This procedure is required only for long-term storage.

WARNING: Do not inhale anesthetic vapors while draining the vaporizer. Uncontrolled inhalation of anesthetic vapors is injurious to health.

WARNING: The vaporizer handwheel must be set to 0 (zero-point interlock) before the vaporizer can be drained.

- a. With the vaporizer in an upright position, turn the handwheel to 0 and make sure the button engages in the locked position. Wait 5 seconds for the pressure to equalize.
- b. Hold an empty anesthetic-specific bottle under the drain hole. Mark the bottle to indicate that it contains a previously used anesthetic agent.

Figure 4-8. Draining the Vaporizer

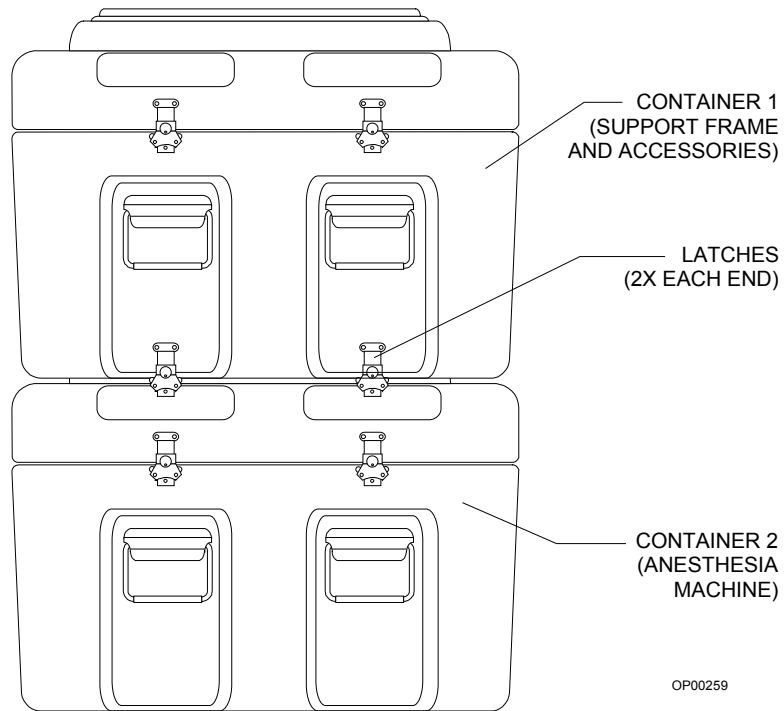


WARNING: Do not reuse drained agent.

- c. Open the drain by turning the drain screw counterclockwise until the agent flows into the bottle. Do not unscrew the thumbscrew completely.
- d. When the vaporizer is empty, turn the drain screw clockwise until the drain is closed.
- e. Place the cap back on the bottle and dispose of the bottle according to approved procedures.

19. Lock the vaporizer handwheel in the T (transport) position. Release the locking handle on the vaporizer and lift the vaporizer from its mount on the machine. Pack it in Container 1.
 20. Remove the filled mesh storage basket and pack it in Container 1.
 21. Remove, clean, and install the ventilator bellows.
 22. Loosen the wing screws securing the anesthesia machine to the support frame. Using the handles on the back of the machine, lift the machine from the support frame and carefully place the machine face down in container 1.
 23. Place the support frame in Container 1 using the following steps:
 - a. Place the front of the frame into the bottom of the container, leaving the locking casters free of the foam for the time being.
 - b. Turn the locking casters so the brakes turn up toward the center of the frame.
 - c. Push the support frame completely into the foam.
- NOTE:** Before closing Container 2, ensure that all instruction manuals and cards are in the container.
24. Close and latch the containers. Engage all the latches, turning each one ½ turn clockwise to secure the lid.
 25. Place Container 1 on top of Container 2. Fasten the latches that join the containers by turning each one ½ turn clockwise.

Figure 4-9. Attaching the Containers for Shipment



Setup and Installation

Setup Checklist

Following is a checklist for the initial setup of a Narkomed M Anesthesia Machine.

1. Set up the support frame as described in the “Unpacking and Storage” section of the manual.
2. Attach the anesthesia machine to the support frame as described in the “Unpacking and Storage” section of the manual.
3. Install the vaporizer.
4. Install the absorber system assembly and fill the absorber canister with absorbent. Refer to the “Cleaning and Routine Maintenance” chapter of this manual for instructions.
5. Install the expiratory valve, respiratory volume sensor assembly, and PEEP valve.
6. Install the display assembly.
7. Install the mesh storage basket on the support frame.
8. Install the scavenger.
9. Install the oxygen cylinder.
10. Connect the gas pipeline supply hoses.
11. Connect the power cord.
12. Install and connect the pressure sensor adapter.
13. Install and connect the oxygen sensor.
14. Connect the breathing circuit and breathing bag.
15. Connect the scavenger system.
16. Fill the vaporizer.
17. Power-up Diagnostic Test.
18. Perform a Periodic Manufacturer's Service (PMS) procedure. This procedure must be performed by a qualified Technical Service Representative as part of the initial setup.

The Testing and Periodic Manufacturer's Service Procedures provided in Section 6 of the Service Manual *must be performed each time the Narkomed M is set up or reinstalled.* This procedure ensures that the anesthesia machine is working properly, which is critical to the health and safety of the patient and the operator.

Figure 5-1. Assembling the Narkomed M (Front View)

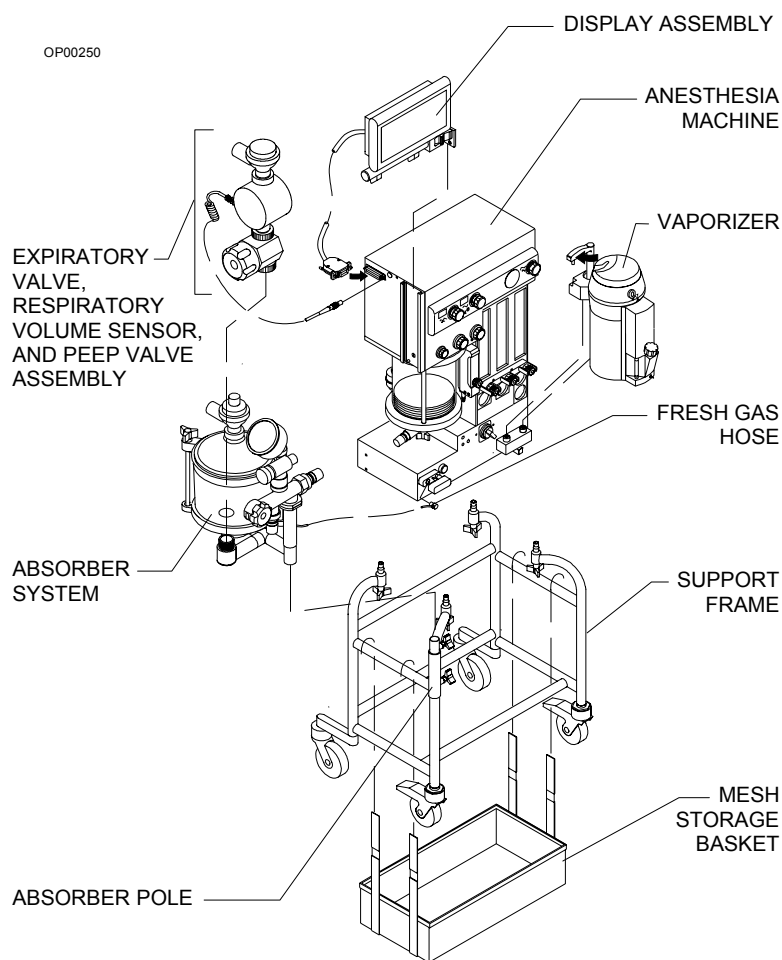
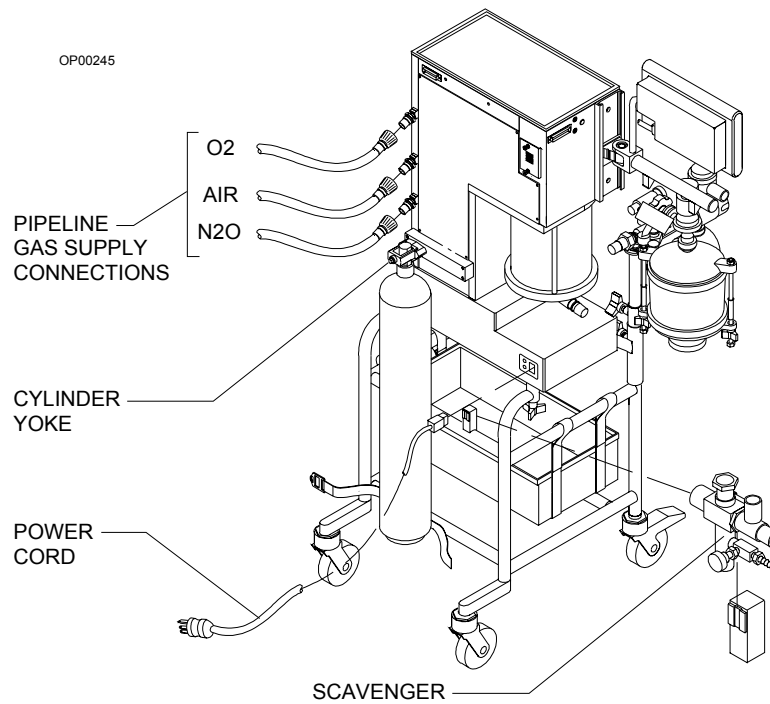


Figure 5-2. Assembling the Narkomed M (Back View)



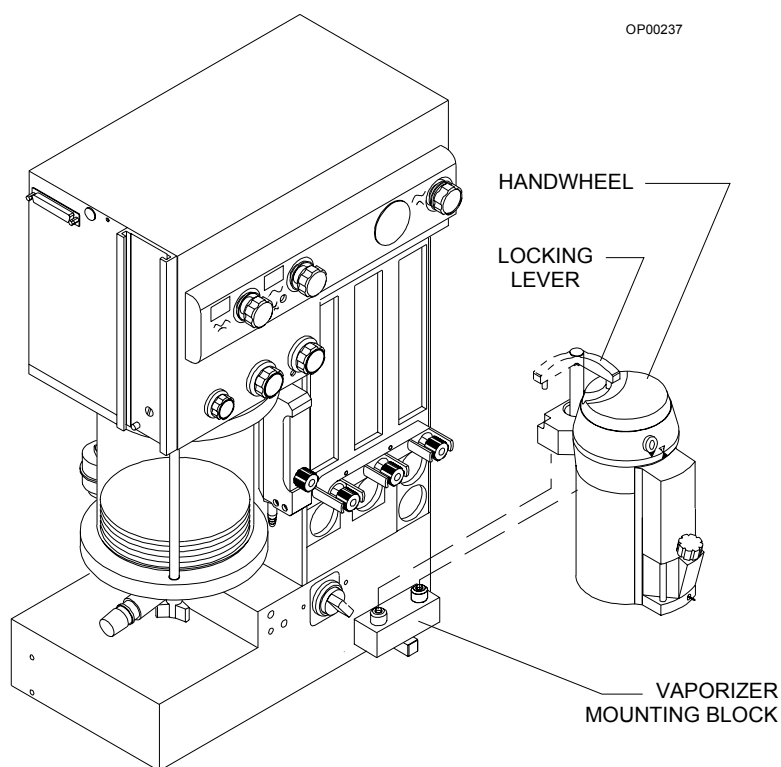
Installing the Vaporizer

If a vaporizer is dropped during handling, or if its handwheel exhibits a lack of resistance (spins freely), or if a gas analyzer maintains a zero reading after the handwheel has been turned to a labeled concentration, do not use the vaporizer. Return the vaporizer to the Draeger Medical, Inc. Technical Service Department.

CAUTION: Handle the vaporizer with care. Do not drop, carry by the handwheel, sealing plug, or locking lever. Damage to the vaporizer will result.

These instructions describe vaporizer installation. Refer to the Dräger-Vapor 2000 Anesthetic Vaporizer Instructions for Use for additional information about the vaporizer.

Figure 5-3. Installing the Vaporizer



To install the vaporizer:

1. Verify that the vaporizer handwheel is locked in the T (transport) position, and that the locking lever is locked in the handwheel.
2. Place the vaporizer on the ports in the vaporizer mounting block and turn the locking lever clockwise until the vaporizer is locked securely on the mounting block on the front of the machine.

Installing the Absorber System

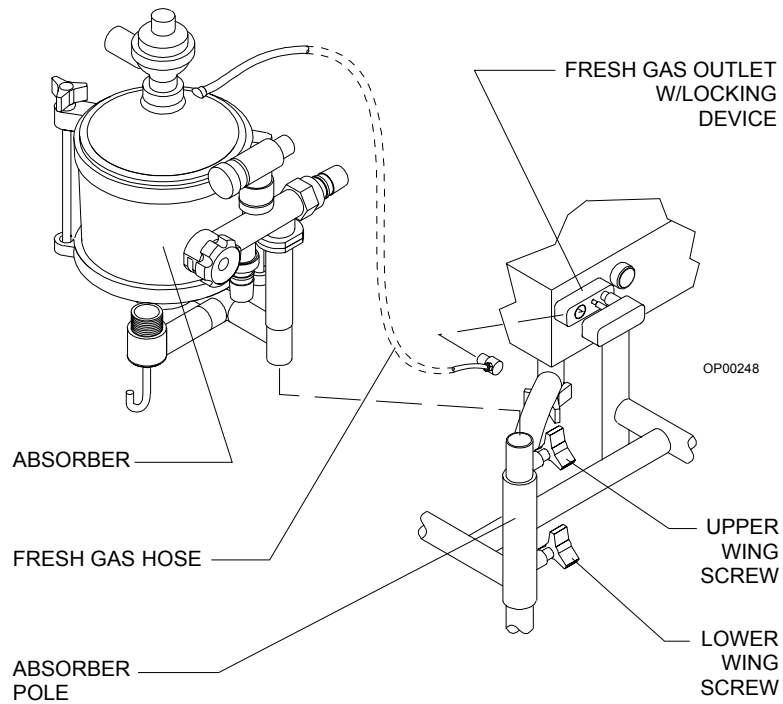
Install the absorber system as described below. This installation procedure presumes the use of an appropriate scavenger system. Make sure both wing screws on the absorber pole are in the open position before proceeding.

1. Place the absorber mounting stud on the absorber pole. Loosely tighten the upper wing screw to lock the assembly to the absorber pole.
2. Loosen the lower wing screw to raise the absorber system to the preferred height. Tighten the wing screw to hold the absorber at that height.
3. Loosen the upper wing screw and rotate the absorber system to the preferred position. Tighten the upper wing screw to hold the absorber in position.

WARNING: Do not pinch or kink the fresh gas hose leading from the fresh gas outlet to the absorber.

4. Connect the fresh gas hose to the fresh gas outlet on the machine.

Figure 5-4. Attaching the Absorber to the Support Frame

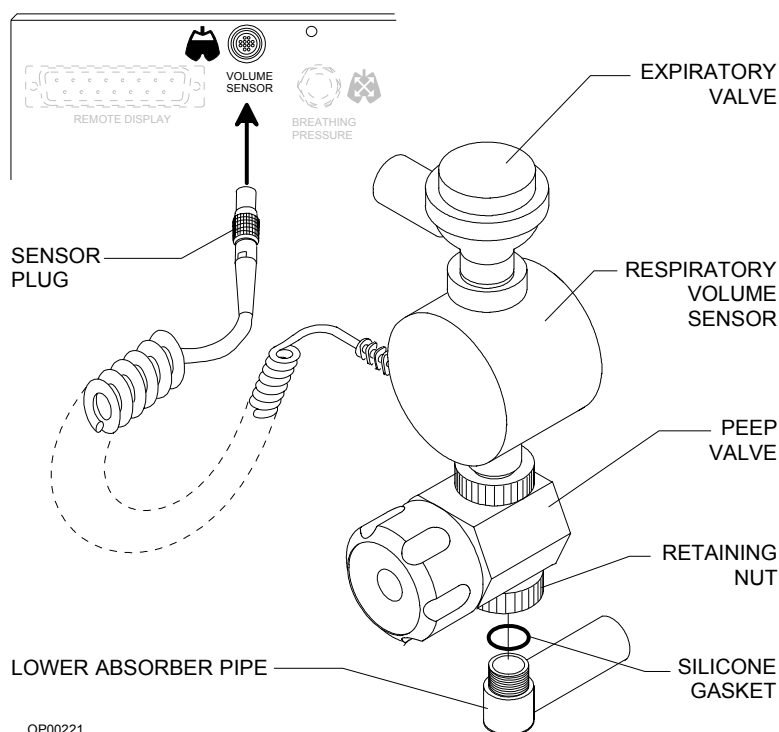


Installing the Expiratory Valve, PEEP Valve and Respiratory Volume Sensor

The expiratory valve, PEEP valve and volume sensor are preassembled as shown in the illustration. Install this assembly on the absorber:

1. Verify that the silicone gasket is properly seated on the threads of the lower absorber pipe.
2. Attach the assembly to the lower absorber pipe by screwing the sensor retaining nut on the threads of the lower absorber pipe. Hand-tighten only.
3. Verify that the PEEP valve and expiratory valve connections are secure. Hand-tighten only.
4. Connect the sensor cord to the VOLUME SENSOR receptacle on the side of the monitor housing.

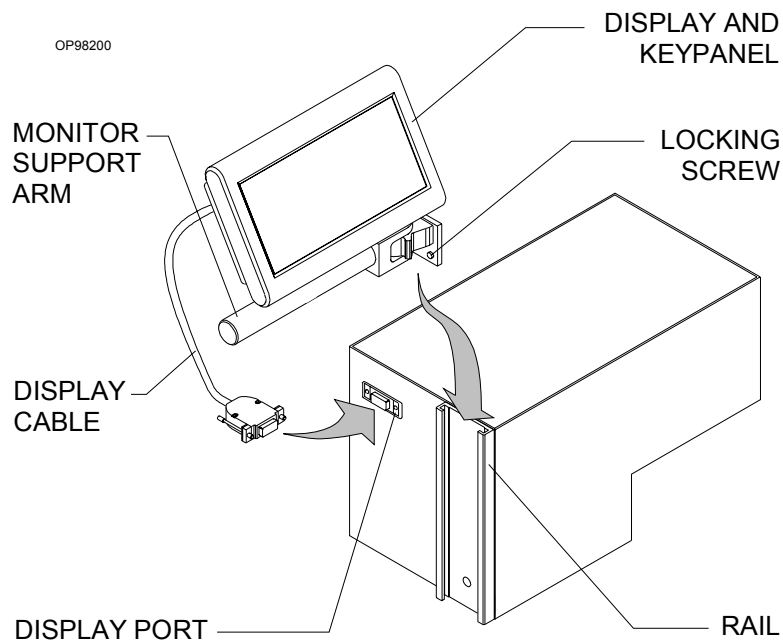
Figure 5-5. Installing the Expiratory Valve, PEEP Valve, and Respiratory Volume Sensor



Installing and Connecting the Display and Monitor Support Arm

1. Slide the display and monitor support arm assembly into the rail on the left side of the monitor housing. Hold the assembly at the preferred height and tighten its locking screw to hold it in position.
2. Connect the cable from the display panel to the remote display port on the side of the machine. Tighten the retaining screws on the connector shell.

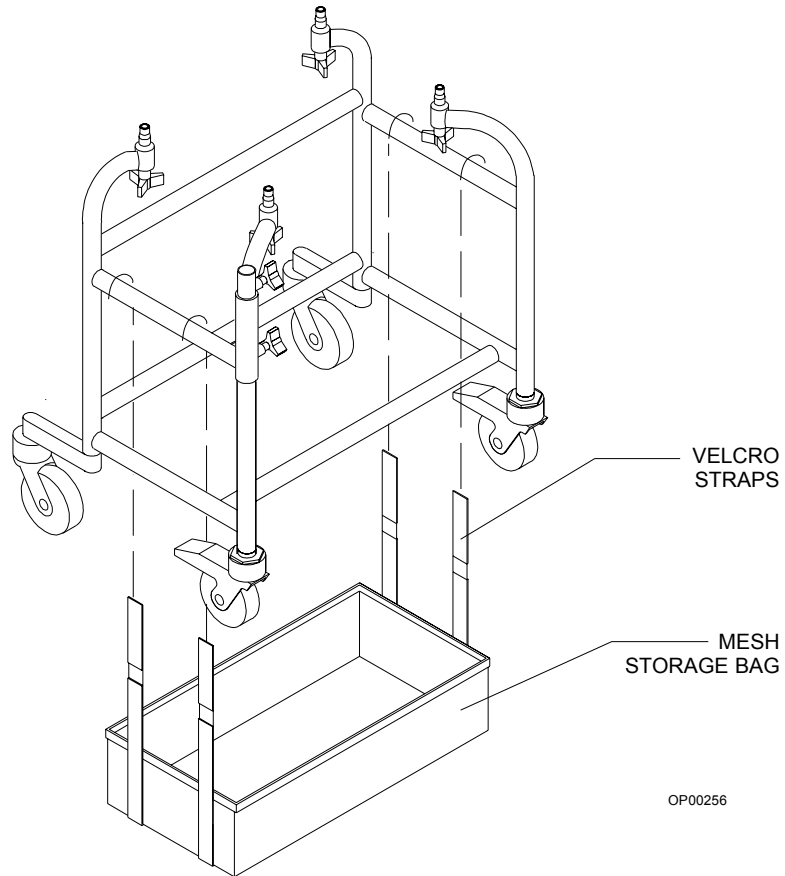
Figure 5-6. Installing the Display and Monitor Support Arm



**Installing the
Mesh
Storage
Basket**

1. Empty the accessories out of the mesh storage basket.
2. Wrap the Velcro straps around the side frame rails at the top of the support frame.

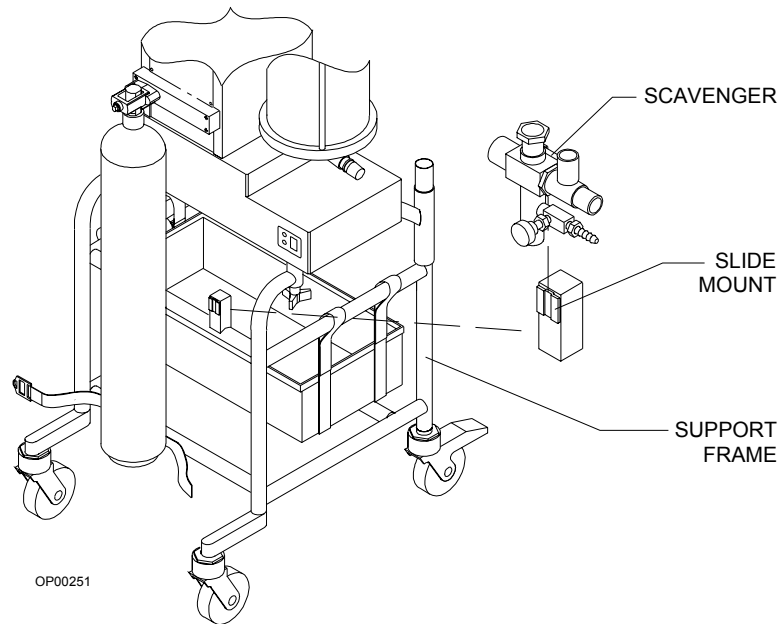
Figure 5-7. Attaching the Mesh Storage Bag



Installing the Scavenger

1. Remove the scavenger from its box.
2. Slide the bracket on the scavenger over the slide mount located on the top back bar of the support frame.

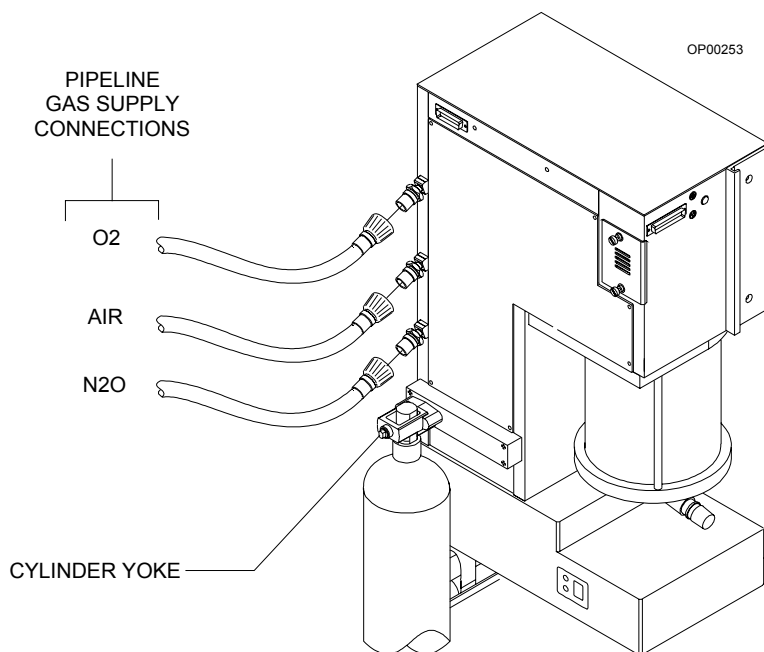
Figure 5-8. Installing the Scavenger



Gas Supply Connections

Gas supply connections are located on the back of the Narkomed M.

Figure 5-9. Gas Supply Connections



WARNING: Oil and grease may combine explosively with oxygen or nitrous oxide. For this reason, oil and grease must never come in contact with pipelines, cylinders, cylinder valves, gauges, fittings, etc., that conduct oxygen or nitrous oxide within the machine. For further information regarding safety precautions in the use of medical gases, consult Compressed Gas Association pamphlet P-2 and appropriate sections of National Fire Protection Association Standard 99.

Connecting the Oxygen Cylinder

The Narkomed M is equipped with an ANSI standard pin-indexed hanger yoke for an E-size gas cylinder. Attach the cylinder as follows:

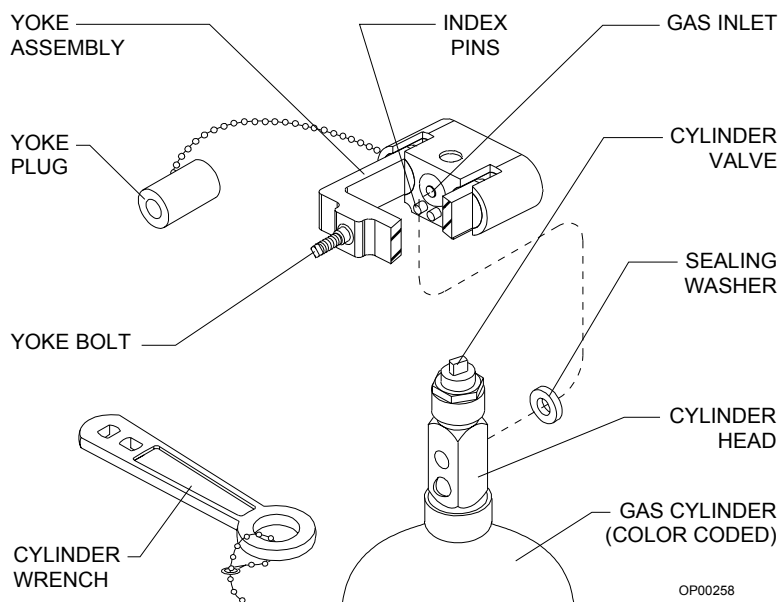
1. Loosen the hinged cylinder yoke with the cylinder wrench, remove the yoke plug, and swing the yoke down.
2. Place a new sealing washer on the seat of the yoke gas inlet connection.

WARNING: Use only one cylinder washer. Using more than one washer could cause leakage of the cylinder gas and compromise the pin indexing system.

3. Verify the presence and integrity of the two index pins below the gas inlet.

WARNING: Check the cylinder yoke for the presence of two index pins each time a cylinder is attached to the machine.

Figure 5-10. Connecting the Oxygen Cylinder



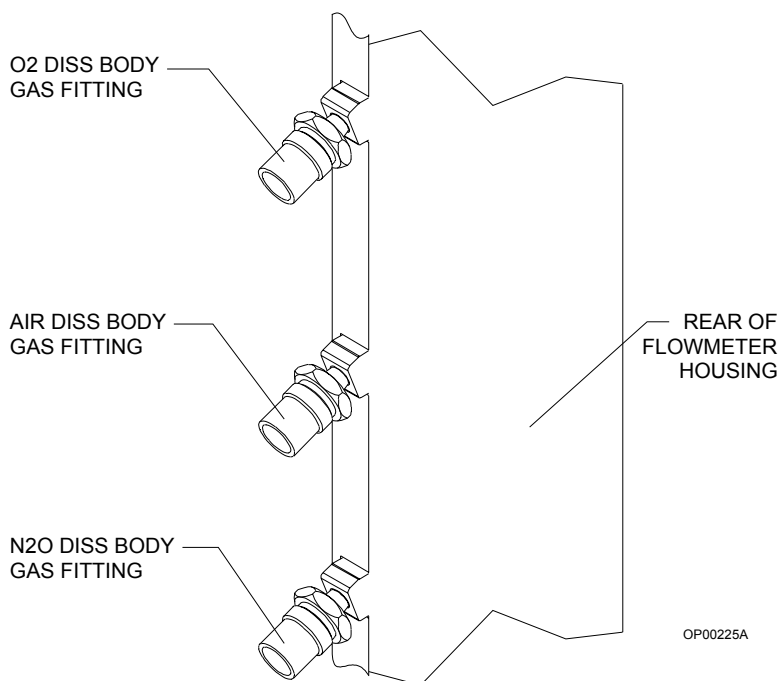
4. Insert the head of the cylinder into the yoke from below, so that the gas outlet and indexing holes on the cylinder head are facing the gas inlet and indexing pins on the yoke.

5. Engage the indexing holes with the index pins. Screw the yoke bolt clockwise against the cylinder head, so that the point of the bolt is aligned with the countersunk recess on the back of the cylinder head.
6. Verify that the sealing washer is in place, that the index pins are engaged, and that the cylinder hangs vertically. Tighten the bolt securely with the cylinder wrench, and fasten the strap at the lower frame rail around the cylinder.

**Connecting
the Pipeline
Gas Supply**

Pipeline connections for oxygen, nitrous oxide and air are located on the back of the flowmeter housing.

Figure 5-11. Pipeline Gas Inlets



The pipeline inlets are marked with color-coded labels for each gas. The pipeline gas hoses are similarly color-coded.

GAS SYSTEM COLOR CODING		
GAS	MARKING	COLOR
Air	AIR	Yellow
Nitrous Oxide	N ₂ O	Blue
Oxygen	O ₂	Green

WARNING: Oil and grease can combine explosively with oxygen or nitrous oxide. For this reason, oil and grease must never come in contact with pipelines, cylinders, cylinder valves, gauges, fittings, etc. that conduct oxygen or nitrous oxide within the machine. For further information regarding safety precautions in the use of medical gases, consult Compressed Gas Association pamphlet P-2 and appropriate sections of National Fire Protection Association Standard 99.

Connect the pipeline supply hoses as follows:

1. Verify that the hoses have the correct DISS fittings. Connect the gas fitting on each supply hose to the corresponding gas fitting on the side of the flowmeter housing.

WARNING: Both ends of each gas supply hose must be indexed for the same gas. Pipeline delivery hoses used between wall outlets and anesthesia machines have caused accidents when, during assembly, an oxygen fitting has been placed on one end of the hose and a nitrous oxide fitting on the other end.

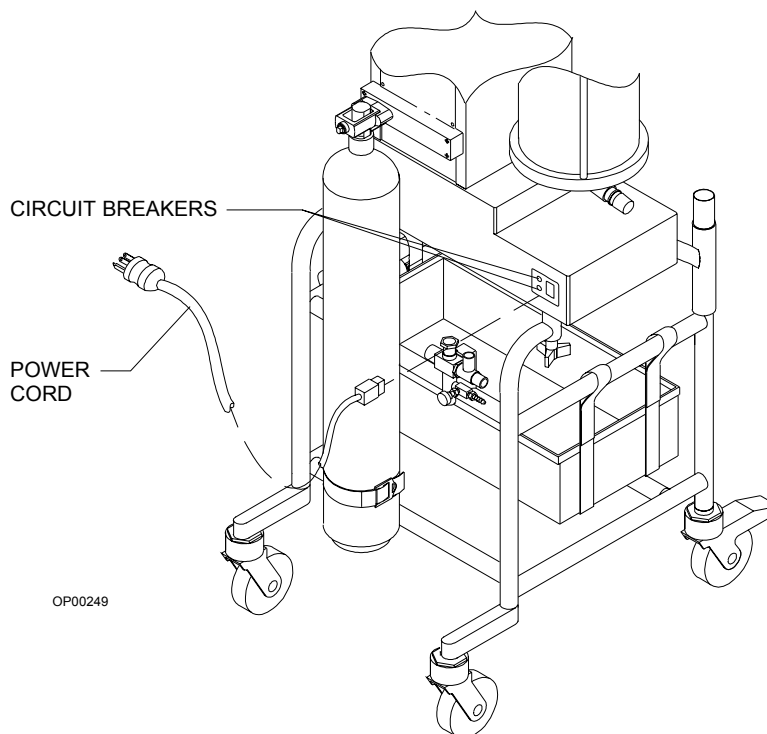
2. Connect the other end of each supply hose to the appropriate functioning hospital pipeline outlet.
3. Check the pipeline pressure gauge on the front of the Narkomed M for sufficient pipeline pressure (50-55 psi).

**Connecting
the
Narkomed M
to Electrical
Power**

The Narkomed M is equipped with a power cord and a hospital grade plug for 117 VAC primary electrical power. Connect the Narkomed M to electrical power:

1. Set the System Power switch is set to STANDBY.
2. Enable all circuit breakers by placing them in the “set” (pushed in) position.
3. Connect the female end of the power cord to the power inlet connector on the bottom of the anesthesia machine.
4. Plug the power cord into an active AC hospital grade outlet.

Figure 5-12. Attaching the Power Cord to the Anesthesia Machine

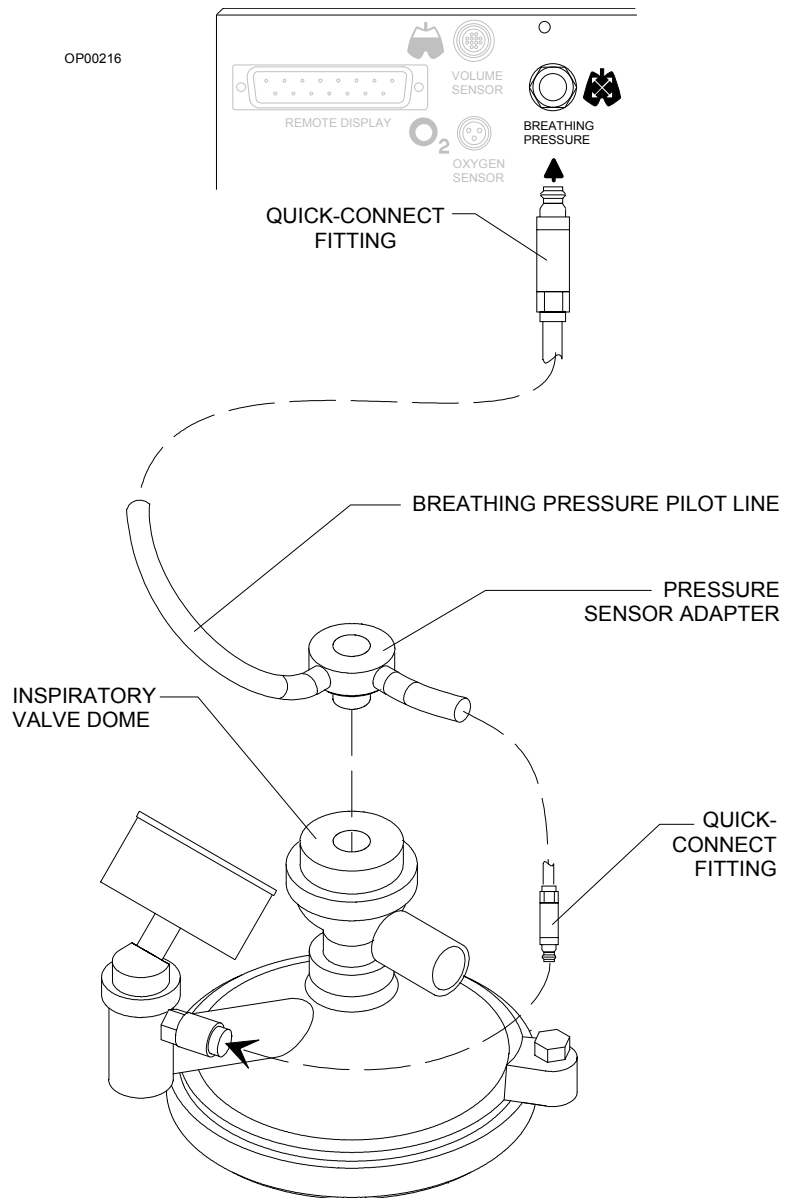


**Installing
and
Connecting
the
Breathing
Pressure
Sensor
Adapter**

Install the breathing pressure sensor adapter as shown in the illustration.

1. Pull the inspiratory valve dome plug from the inspiratory valve dome.
2. Insert the pressure sensor adapter into the inspiratory valve dome by pressing it into place. Verify that there is a line connected to each hose barb on the adapter and that each line is secured with a press-on clamp.
3. Join the long end of the hose assembly to the breathing pressure monitor connector on the side of the monitor housing.
4. Join the short end of the hose assembly to the connector at the breathing pressure gauge.

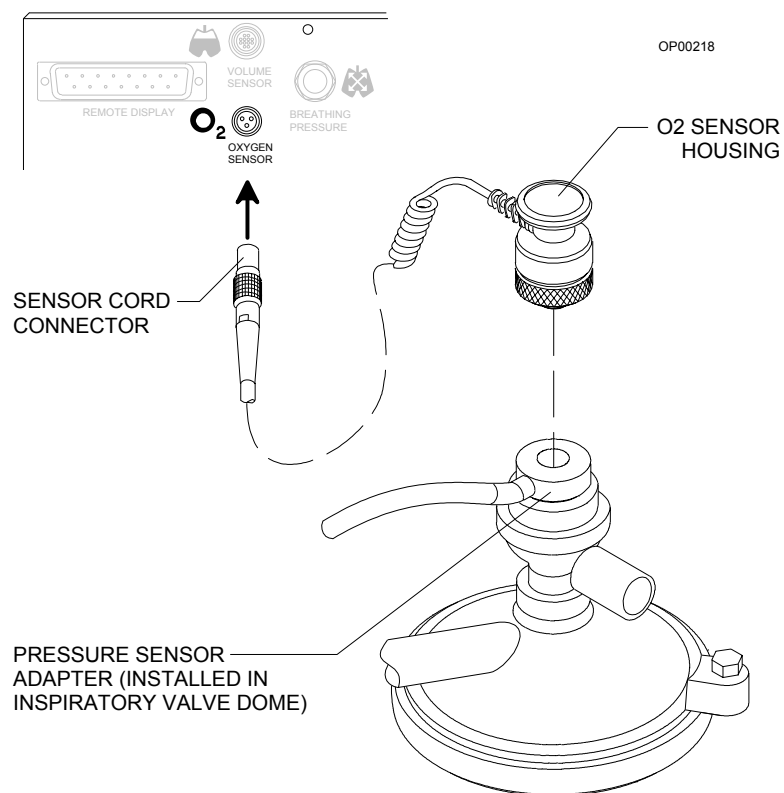
Figure 5-13. Installing the Breathing Pressure Sensor Adapter



**Installing
and
Connecting
the Oxygen
Sensor**

1. Connect the sensor cord to the O₂ SENSOR receptacle on the side of the monitor housing.
2. Remove the cap from the sensor housing.
3. Perform an oxygen sensor calibration as described in “Calibrating the Oxygen Sensor” in Section 9 of this manual.
4. Press the sensor housing into the pressure sensor adapter.

Figure 5-14. Connecting the Oxygen Sensor



**Connecting
the
Breathing
Circuit**

WARNING: The Narkomed M patient breathing system must not be used in conjunction with any additional components that establish a flow direction.

WARNING: Hoses and bags attached to the 22 mm hose terminals of the inspiratory valve, expiratory valve, ventilator hose connection, and breathing bag mount must comply with current ANSI standards.

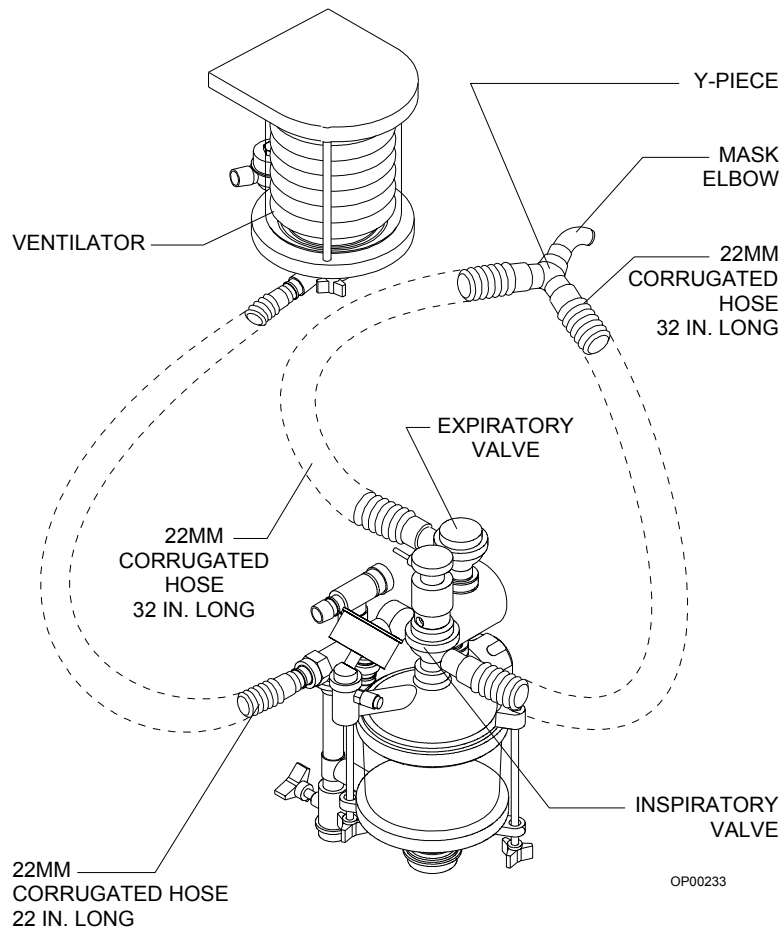
WARNING: To prevent leaks and misdirection of gas pathways, all hoses should be correctly and tightly fitted, as shown in the illustrations. Take special care to make sure that all 19 mm hoses are attached to the proper 19 mm connectors. Possible machine malfunction and harm to the patient could occur if the scavenger hoses are attached to any 22 mm connection.

1. Attach a 22 mm breathing hose between the ventilator bellows 22 mm terminal marked VENTILATOR HOSE, and the 22 mm terminal on the rear of the manual/automatic selector valve marked VENTILATOR HOSE.
2. Attach a 22 mm breathing hose between the 22 mm hose terminal on the inspiratory valve marked INSPIRATION, and one side of the Y-piece.

WARNING: To ensure proper direction of gas flow during inspiratory and expiratory phases, the disks in the inspiratory and expiratory valves must move freely, without sticking.

3. Attach a 22 mm breathing hose between the other side of the Y-piece and the 22 mm hose terminal on the expiratory valve marked EXPIRATION.

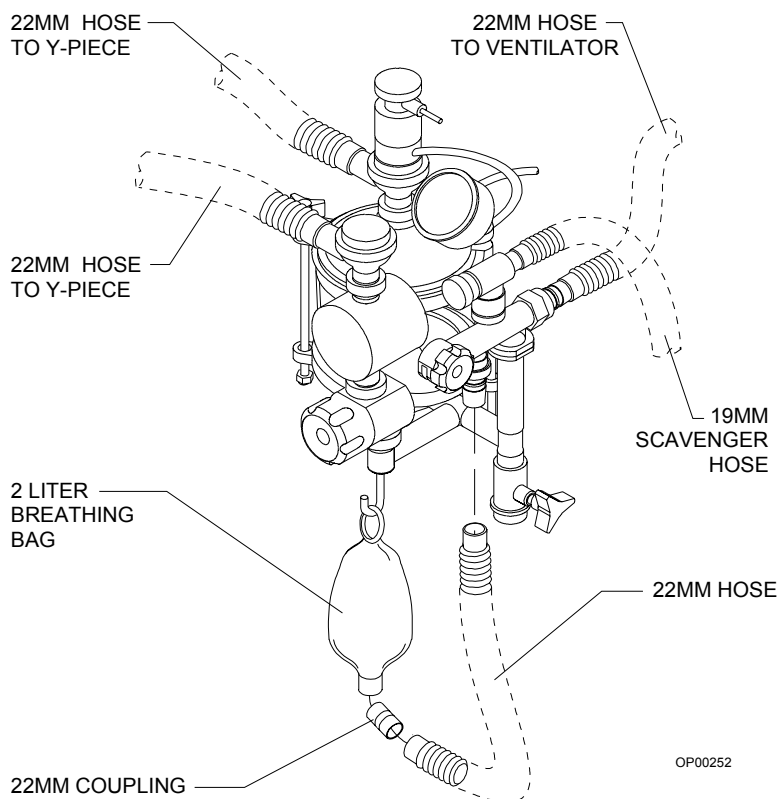
Figure 5-15. Connecting the Breathing Circuit



4. Attach a breathing bag, with a 22 mm extension hose to the terminal on the bottom of the manual/automatic selector valve. Place the breathing bag hanger loop on the hook below the selector.

WARNING: The breathing bag acts as a pressure-limiting device during manually assisted and spontaneous ventilation. Breathing bags used with the absorber system must comply with the pressure/volume requirements of current ANSI standards. A breathing bag that has been previously stretched may have drastically altered compliance characteristics, and altered conductivity in the case of conductive bags.

Figure 5-16. Connecting the Breathing Bag to the Absorber System



**Connecting
the
Scavenger
System**

The scavenger interface can be connected to a suction or passive waste gas removal system. Before installing the scavenger, determine which system will be used.

1. Connect a 19 mm hose between the 19 mm terminal labeled SCAVENGER HOSE on the ventilator relief valve and the 19 mm terminal labeled SCAVENGER HOSE on the left side of the scavenger.

WARNING: The 19 mm scavenger hose leading from the ventilator relief valve must not be pinched, kinked, or blocked in any manner.

CAUTION: Take special care not to accidentally force 19 mm scavenger hoses over 22 mm breathing hose terminals. Carefully follow the hose connection instructions for installing the scavenger and the absorber.

2. Connect a 19 mm hose between the 19 mm terminal labeled SCAVENGER HOSE on the back of the APL valve and the 19 mm terminal labeled SCAVENGER HOSE on the right side of the scavenger.

WARNING: The 19 mm scavenger hoses leading from the absorber system must not be pinched, kinked, or blocked in any manner.

3. If a passive system is used, connect the exhaust hose to the waste gas exhaust port at the bottom of the scavenger. Make sure the needle valve is turned off. If a suction system is used, connect the vacuum hose to the vacuum hose terminal on the scavenger and attach the 3-liter bag with the magenta coupling to the waste gas exhaust port at the bottom of the scavenger.
4. Perform an initial adjustment on the needle valve.
 - a. Attach a breathing bag and a Y-piece to the absorber system.
 - b. Attach the bag adapter and a solid black breathing bag to the Y-piece.
 - c. Set the manual/automatic selector valve to BAG and set the ventilator to the preferred frequency.

Figure 5-17. Connecting the Scavenger Interface for Passive Systems

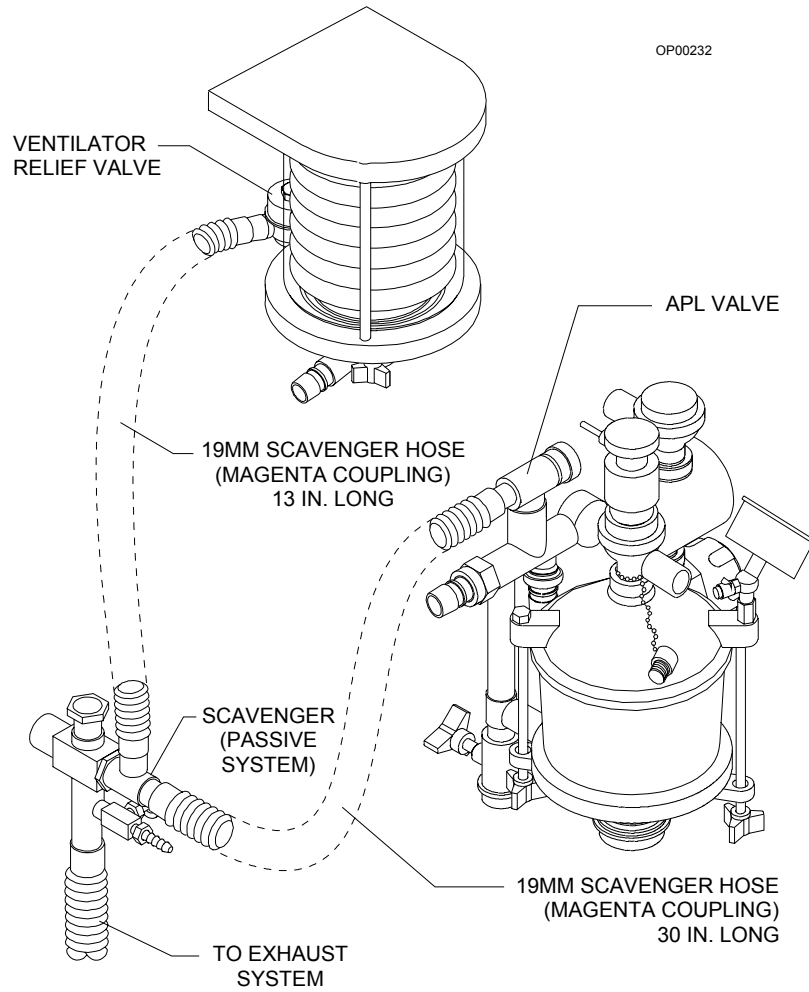
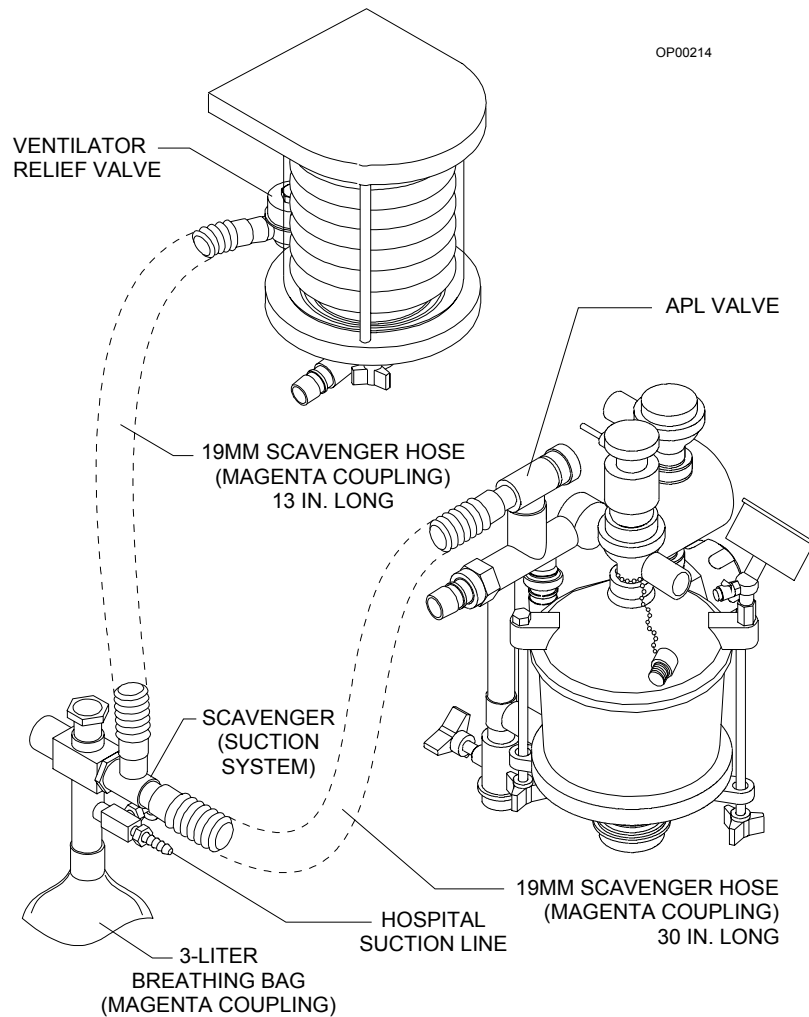


Figure 5-18. Connecting the Scavenger Interface for Suction Systems



- d. Adjust the O₂ flow control valve to the expected total flow of all gases.
- e. Verify that the suction disposal system is active.
- f. Watch the scavenger reservoir bag as the oxygen flow passes through the scavenger. The bag should not overextend or collapse.
- g. Adjust the needle valve to provide either more or less suction.

**Connecting
the
Breathing
Bag**

- 1. Hook the 2-liter breathing bag to the bag hook on the absorber system.
- 2. Insert the 22 mm coupling into the bag.
- 3. Attach one end of the 22 mm, 32-inch long hose to the coupling.
- 4. Attach the other end of the hose to the breathing bag fitting under the manual/automatic selector valve on the absorber assembly.

Filling the Vaporizer

WARNING: Do not inhale anesthetic vapors while filling the vaporizer.

Before filling the vaporizer, note the expiration date of the anesthetic agent.

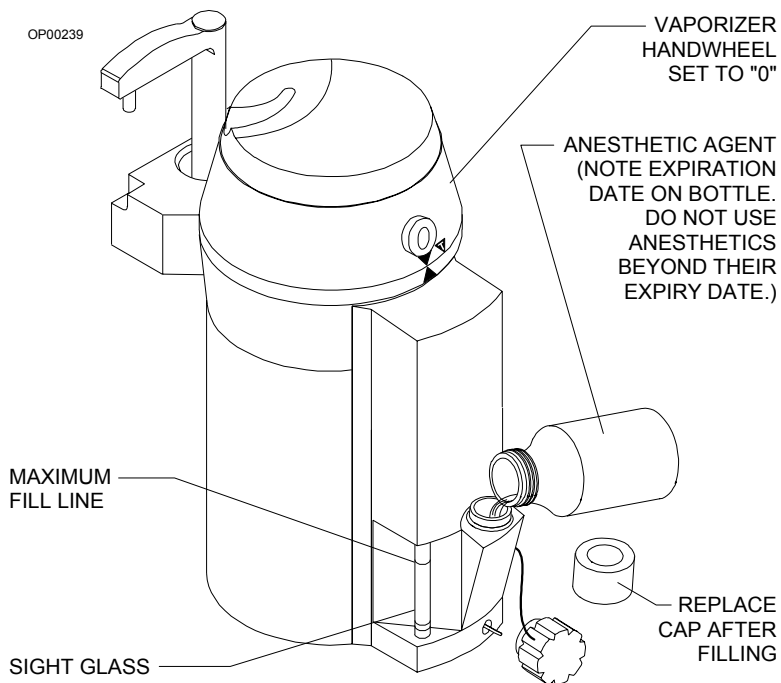
WARNING: Be sure to fill the vaporizer in an upright position. Filling the vaporizer in a tilted position can cause overfilling. Overfilling causes the anesthetic concentration output to be higher or lower than the handwheel setting.

Do not use anesthetics beyond the date of expiration.

Fill the vaporizer if the level indicated in the sight glass is below the maximum mark.

CAUTION: The vaporizer is specifically designed and calibrated for one particular anesthetic agent. Do not fill the vaporizer with any anesthetic other than the particular agent indicated on the vaporizer.

Figure 5-19. Filling the Vaporizer



1. Press the button on the vaporizer handwheel and turn it to the 0 (zero-point interlock) and verify that the button engages in the locked position.

WARNING: The vaporizer handwheel must be set to 0 (zero-point interlock) before the vaporizer can be filled.

2. Remove the cap and seal from the anesthetic agent bottle. Verify that the sealing edge of the bottle is not chipped or damaged.
3. Verify that the drain valve is closed.
4. Unscrew the tethered sealing plug from the filling spout.
5. Carefully pour the anesthetic agent into the filling spout. As the agent is poured, observe the level through the sight glass. Carefully fill the vaporizer to the maximum mark (Do not fill beyond the maximum mark), then close the filling spout by screwing on the sealing plug.

NOTE: The vaporizer can be filled on or off the machine. However, the vaporizer must not be tilted while being filled. Filling the vaporizer in a tilted position may cause overfilling. Overfilling may cause the anesthetic concentration to be higher or lower than the handwheel setting.

NOTE: The capacity of the vaporizer is approximately 300 cm³ with wet wick, and approximately 360 cm³ with dry wick. There is approximately 260 cm³ between the low level mark and the maximum mark.

If the vaporizer is inadvertently overfilled, drain the excess anesthetic. For information on draining the vaporizer, refer to the Dräger-Vapor 2000 Anesthetic Vaporizer Instructions for Use.

Power-Up Diagnostics Test

1. Turn the Narkomed M System Power switch to ON. The self-diagnostic screen is displayed. A typical power-up diagnostic screen is shown in the illustration.
2. Verify that the power on indicator light is on.
3. Verify that all circuit breakers remain in the “set” (pushed in) position.

DIAGNOSTIC TESTS


COPYRIGHT 1998, NAD INC.

FIRMWARE	PASS	SOFTWARE ID: xxxx
RAM	PASS	
VIDEO	PASS	
A/D CONVERTER	PASS	
AUDIO -PRIMARY	PASS	
-BACKUP	PASS	
SERIAL I/O	PASS	
CLOCK	PASS	
NON-VOLATILE MEMORY	PASS	

FUNCTIONAL

Daily and Preuse Checkout Procedures

Daily Checkout Procedure


Before operating the Narkomed M, the following checkout procedure must be performed to make sure the machine is ready for use. This is a recommended procedure. Follow your institution's policies for specific checkout procedures. If the anesthesia system fails any procedures identified by an important note symbol , do not use the machine. Contact a qualified technical service representative for inspection of the unit.

NOTE: Do not insert any additional components into, or modify, the anesthesia system after the checkout procedure is started.


Initial Setup and Verification

1. Enter the serial number located on the back of the anesthesia machine.
2. Make sure there is a valid inspection sticker on the back of the machine indicating that the anesthesia machine was serviced and inspected by a qualified technical service representative.
3. Verify that a cylinder wrench is tethered next to the cylinder yoke.
4. If the anesthesia machine is not already plugged in, connect the electrical power cable to an active AC outlet that accepts and properly grounds the power cable. **Do not** use “cheater” plugs.

System Software Diagnostics


5.  Turn the SYSTEM POWER switch to the ON position. Wait for the machine to complete its diagnostic checks. Make sure the system is functional.

Battery Power Verification


6.  Check the reserve battery power. Remove the power cable from the outlet. Press the BATTERY TEST button. The green indicator must light. Plug the power cable back into the electrical outlet.

NOTE: This test assumes that the anesthesia machine has been plugged in for 12 hours. The battery charging system works only when the machine is connected to an active AC power source. The charging system takes about 12 hours to charge a fully discharged battery.

**Emergency
Ventilation
Equipment
Verification**

7.  Verify that backup ventilation equipment is available and functional.

**High
Pressure
System
Verification**


8.  Check the oxygen cylinder supplies.
 - a. Disconnect all pipeline gas supply hoses and drain the system.
 - b. Close the oxygen cylinder valve and remove the cylinder from the yoke. Verify that there is one cylinder gasket and there are two index pins. Verify that the cylinder matches the yoke label. Replace the cylinder.
 - c. Open an oxygen cylinder and check the cylinder pressure gauge. A full oxygen cylinder registers about 1900 psi. Replace any cylinder with pressure less than 1000 psi. To check for a high pressure leak, close the cylinder and observe the cylinder pressure gauge for a prominent decrease in the pressure. With the oxygen cylinder closed, press the oxygen flush button on the front of the anesthesia machine. Hold the button in until the pressure gauges indicate no pressure.

The full and minimum pressures for the oxygen cylinder:


GAS	PSI - FULL	PSI - MIN
Oxygen	1900	1000

Indicated pressures are for an E-size cylinder at 70°F (21°C)


**Pipeline
Supply
System
Verification**

9.  Pipeline Supply Verification
 - a. Inspect the supply hoses for cracks or wear.
 - b. Connect the appropriate pipeline supply hoses to the pipeline inlet connectors.
 - c. Check for sufficient pipeline pressure readings for each gas on the pipeline pressure gauges located below the flow control valves. The pressure for each gas must be between 50–55 psi. Open the flow control valve for each gas to a moderate value. The pressure indicated at the pipeline pressure gauge must not decrease more than 5 psi.
 - d. Verify that the correct gases are supplied to the anesthesia machine inlets.


**Low
Pressure
System
Verification**

10.  Vaporizer Verification
 - a. Check for sufficient supply of liquid anesthetic in the vaporizer. Fill the vaporizer with liquid anesthetic to the maximum fill line.
 - b. Make sure the cap is on the spout and the drain is completely closed.
 - c. Make sure the handwheel is set to 0.


**System Gas
Circuit
Verification**

11.  Check the flowmeters. Adjust the flow control knob for each gas and verify the proper operation of the corresponding flowmeters. The float must move freely over the full range of each flowmeter.


**Oxygen
Monitor
Calibration**

12.  Calibrate the oxygen monitor by exposing the sensor to ambient air and activate the calibration key. (See *Operation - Oxygen Monitoring* "Calibrating the Oxygen Sensor" in Section 5 for more information.)
 - a. Place the oxygen sensor securely in the sensor mount.
 - b. Verify that the correct gas concentration is supplied to the anesthesia system from the supply cylinder.
 - c. Close the cylinder supply and deplete the pressure from the system.

**OFPD
Verification**


13.  Check the oxygen failure protection device. With all gases available on the machine set to a flow of about 4 L/min, close the oxygen supply by disconnecting the oxygen pipeline supply hose and closing the oxygen cylinder. The flow of all other gases indicated by their flowmeters must decrease in proportion to the decrease in oxygen flow and eventually shut off.

**ORC
Verification**


14.  Check the function of the ORC. With the nitrous oxide flow control valve open to a flow of 8 L/min, vary the oxygen flow with the oxygen flow control valve. The nitrous oxide flow indicated on the nitrous oxide flowmeter must automatically vary in response to the adjustment of the oxygen flow control valve.

The ORC must maintain a fresh gas oxygen/nitrous oxide flow ratio of at least $25 \pm 4\%$ oxygen.


**Oxygen
Flush
Verification**


15.  Check the oxygen flush:
- Press the oxygen flush button and listen for an audible gas flow sound, accompanied by a marked increase in oxygen concentration in the breathing system.
 - Check the delivered oxygen concentration. Repeatedly flush the patient breathing system by pressing the oxygen flush button. Open the oxygen flow control valve to a flow of 8 L/min and close the other flow control valves. The oxygen measurement display area should indicate 97% to 100% oxygen concentration.

**Fresh Gas
Verification**

16.  Make sure the handwheel is set to 0. Open the oxygen flow control valve to an 8 L/min flow and close all other flow control valves. Sniff the gas coming from the fresh gas common outlet. There should be no noticeable odor.

**Absorber
System
Verification**

17.  To check the absorber system:
- Check the hose connections in the breathing system.
 - Make sure the fresh gas hose of the breathing system is securely connected to the fresh gas outlet.
 - Make sure a 22 mm patient breathing circuit is connected between the inspiratory and expiratory valves on the absorber.
 - Make sure a 22 mm breathing hose is connected between the ventilator hose terminal and the manual/automatic selector valve breathing hose terminal.
 - Make sure a breathing bag of proper capacity and appropriate construction is connected to the breathing bag terminal of the breathing system.
 - Make sure the breathing pressure hose assembly is properly connected between the pressure sensor adapter and the system interface panel.
 - Make sure the oxygen sensor and respiratory volume sensor are properly installed.

18.  Make sure the absorber canister is filled with CO₂ absorbent. Consult the absorbent manufacturer's literature for information on what signs to expect when the absorbent is exhausted. Make sure that the color change represents the absorbent's true state of depletion and is not due to regeneration after a rest period. Flushing the anesthesia machine continuously for at least one minute with 100% oxygen before the first case of the day is recommended.

If the anesthesia machine has been out of use or in storage, replace the absorbent before using the machine. Draeger Medical, Inc. recommends establishing a routine schedule with a sufficient safety margin for replacing the absorbent.


Remove accumulated absorbent dust and water from the absorber dust cup.

WARNING: Absorbent is caustic and is a strong eye, skin, and respiratory tract irritant. When emptying the absorber dust cup, take care not to spill its caustic contents.

NOTE: When changing the CO₂ absorbent, take care not to chip or crack the absorbent canister. Check the canister for signs of damage, especially along the rim before reinstallation.

19. Close the vaporizer and all gas flow sources. Check for free gas passage in the patient breathing system. Wear a surgical mask to inhale and exhale through the breathing system (each limb individually, if possible). Verify the unidirectional flow in each limb and then reconnect the tubing.

**APL Valve
Verification**

20.  Check the APL valve to be sure it can relieve excess gas from the breathing system into the scavenger system.

To check the APL valve's flow resistance:

- a. Set the manual/automatic selector valve to BAG.
- b. Remove the bag from the bag mount.
- c. Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm hose.
- d. Completely open the APL valve by turning the control knob fully counterclockwise to its stop position.
- e. Turn the SYSTEM POWER switch to ON.

- f. Open the oxygen flow control valve to a flow of 8 L/min.
- g. Occlude the bag mount opening and watch for a pressure increase on the breathing system pressure gauge. This pressure increase must not exceed 3 cmH₂O.


**Breathing
System Leak
Test**

21. Perform a breathing and fresh gas delivery system pressure test. This test detects leaks from the patient breathing system and fresh gas delivery system.

To perform the test:

- a. Close all flow control valves on the anesthesia machine.
- b. Turn the SYSTEM POWER switch to the STANDBY position.
- c. Turn the vaporizer to 0% concentration.
- d. Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm breathing hose.
- e. Set the manual/automatic selector valve to BAG.
- f. Close the APL valve by turning the knob fully clockwise to its stop position.
- g. Check that the breathing pressure gauge is on 0.
- h. Attach the supplied test terminal to the breathing bag mount.
- i. Connect a sphygmomanometer squeeze bulb (available from Draeger Medical, Inc.) to the hose barb on the test terminal.
- j. Pump the squeeze bulb by hand until the breathing system pressure gauge indicates pressure of at least 50 cmH₂O (not to exceed 80 cmH₂O).
- k. Observe the pressure drop at the breathing system pressure gauge. When the pressure is at 50 cmH₂O, begin counting seconds. The pressure must not drop more than 20 cmH₂O in 30 seconds.

**Scavenger
System
Verification**

22.  Verify the performance of the scavenger system.
- To test negative pressure relief:
- a. Connect a 19 mm scavenger hose to the ventilator relief valve and the scavenger interface.
 - b. Connect a 19 mm scavenger hose between the APL valve and the scavenger interface.
 - c. Connect the 3.0 liter reservoir bag to the reservoir bag terminal.
 - d. Connect the scavenger to the suction waste gas disposal system.
 - e. Short circuit the absorber's inspiratory and expiratory valves with a 22 mm breathing hose.
 - f. Set the absorber's manual/automatic selector valve to BAG.
 - g. Turn the APL valve fully counterclockwise.
 - h. Verify that the suction waste gas disposal system is active.
 - i. Open the scavenger needle valve enough to allow typical suction through the scavenger.
 - j. Close all flow control valves on the anesthesia machine.
 - k. Occlude the absorber breathing bag mount. At this point, the breathing pressure gauge should indicate a negligible negative pressure no lower than -1.0 cmH₂O.
- To test positive pressure relief:
- a. Connect a 19 mm scavenger hose to the ventilator relief valve and the scavenger interface.
 - b. Connect a 19 mm scavenger hose between the APL valve and the scavenger interface.
 - c. Connect the 3.0 liter reservoir bag to the reservoir bag terminal.
 - d. Connect the scavenger to the suction waste gas disposal system.

- e. Short circuit the absorber's inspiratory and expiratory valves with a 22 mm breathing hose.
- f. Set the absorber's manual/automatic selector valve to BAG.
- g. Turn the APL valve fully counterclockwise.
- h. Verify that the suction waste gas disposal system is active.
- i. Turn the PEEP valve control knob fully counterclockwise to its lowest setting.
- j. Turn the scavenger needle valve fully counterclockwise.
- k. Push the O₂ flush button to inflate the scavenger reservoir bag.
- l. Open the oxygen flow control valve to a flow of 8 L/min.
- m. Occlude the absorber breathing bag terminal. The oxygen flow should exit through the positive pressure relief valve. The pressure gauge should indicate pressure less than 10.0 cmH₂O.
- n. Adjust the scavenger needle valve to a proper initial setting.

To test the scavenger interface for passive systems:

- a. Make sure a 19 mm scavenger hose is connected between the ventilator relief valve and the scavenger interface.
- b. Make sure a 19 mm scavenger hose is connected between the APL valve and the scavenger interface.
- c. Make sure a 19 mm scavenger hose is connected between the bottom scavenger interface and the hospital exhaust system.
- d. Check for moisture accumulation in the breathing and scavenger hoses. Remove any moisture found.
- e. Short-circuit the absorber's inspiratory and expiratory valves with a 22 mm breathing hose.
- f. Set the absorber's manual/automatic selector valve to AUTO.

- g. Turn the PEEP valve control knob fully counterclockwise to its lowest setting.
- h. Open the oxygen flow control valve to a flow of 10 L/min and occlude the 19 mm scavenger terminal labeled EXHAUST.
- i. After the ventilator bellows inflates, the flow of oxygen exits the system through the positive pressure safety relief valve. At this point, the absorber system's breathing pressure gauge must indicate a pressure of less than 5 cm H₂O.

**Manual and
Automatic
Ventilation
Systems**

23.  Test the ventilator.

- a. Check for proper pressure and flow at the Y-piece during the inspiratory and expiratory phases. Turn the SYSTEM POWER switch and ventilator power switch to their ON positions. Place the manual/automatic selector valve in the AUTO position. Adjust the oxygen flow control valve to a 3 L/min flow. Set the ventilator frequency to 3 BPM, the I:E ratio to 1:2, and the tidal volume to about 1 liter.


Adjust the ventilator flow control to the maximum of the "low" zone on the flow gauge. Occlude the patient side of the Y-piece. Fill the ventilator bellows by pressing the oxygen flush button. Observe the breathing system pressure gauge as the ventilator cycles.

The pressure gauge must indicate a pressure over 30 cm H₂O when the bellows completes its downward travel. The pressure should not exceed 3 cm H₂O at the end of the expiratory phase when the bellows completes its upward travel.

- b. Verify the PEEP valve's performance. Attach a breathing bag to the patient Y-piece with an appropriate adapter such as an NAD combination mask elbow with a 22 mm male fitting for the breathing bag and 15 mm male fitting for the Y-piece. With the manual/automatic selector in the AUTO position, set the ventilator to the preferred frequency.

Then adjust the PEEP valve to different values and observe the breathing system pressure gauge to verify performance. Turn the PEEP valve control knob fully counterclockwise to its lowest setting after the test is completed.

Monitors

24. Check the alarm limit settings. The monitor alarm limits are automatically set to a default configuration when the SYSTEM POWER switch is turned on. Check these settings and adjust them if necessary. Alarm limits can be adjusted at the beginning of or during a procedure. Also, make sure that any external monitors (if any) are connected properly and that the alarms sound through the anesthesia machine's central audio annunciator.
25.  Test the alarm functions for all monitors. Simulate alarm conditions and check for appropriate alarm signals.


System Flush

26. Flush the system for at least one minute with 100% oxygen by pressing the oxygen flush button.

Final Position


27. When the daily checkout procedure is complete, verify that:
 - a. the vaporizer is off (the handwheels is set to zero)
 - b. the vaporizer is filled to the maximum fill line
 - c. the APL valve is open (fully counterclockwise)
 - d. the manual/automatic selector is set to BAG
 - e. all flowmeters indicate 0 (or minimum)
 - f. the breathing system is ready to use (the bag is in place and all hoses are connected properly).

Preuse Checkout Procedure

Perform the following abbreviated checkout procedure when the Narkomed M is used in successive cases. It may be performed only after the initial daily checkout procedure is performed. This is a recommended procedure. Follow your institution's policies regarding specific checkout procedures. If the anesthesia system fails any procedures identified by an important note symbol , do not use the machine. Contact a qualified technical service representative for inspection of the unit.


NOTE: Do not insert any additional components into or modify the anesthesia system after the checkout procedure is started.

Reserve Power Verification


1.  Check the reserve battery power. Turn the SYSTEM POWER switch to the ON position. Remove the power cable from the outlet. Press the BATTERY TEST button on the main switch panel. The green indicator to the left of the test button must light. Plug the power cable back into the electrical outlet.

NOTE: This test assumes that the anesthesia machine has been plugged in for 12 hours. The battery charging system works only when the machine is connected to an active AC power source. The charging system takes about 12 hours to charge a fully discharged battery.

Absorber System Verification

2.  To check the absorber system:
 - a. Check the hose connections in the breathing system.
 - b. Make sure the fresh gas hose of the breathing system is securely connected to the fresh gas outlet.
 - c. Make sure a 22 mm patient breathing circuit is connected between the inspiratory and expiratory valves on the absorber.
 - d. Make sure a 22 mm breathing hose is connected between the ventilator hose terminal and the manual/automatic selector valve breathing hose terminal.
 - e. Make sure a breathing bag of proper capacity and appropriate construction is connected to the breathing bag terminal of the breathing system.
 - f. Make sure the breathing pressure hose assembly is properly connected to the pressure sensor adapter and the system interface panel.

- g. Make sure the oxygen sensor and respiratory volume sensor are properly installed.

3.  Check the CO₂ absorbent in the absorber system. Make sure the absorber canister is filled with CO₂ absorbent. Consult the absorbent manufacturer's literature for information on what signs to expect when the absorbent is exhausted. Make sure that the color change represents the absorbent's true state of depletion and is not due to regeneration after a rest period. Flushing the anesthesia machine continuously for at least one minute with 100% oxygen before the first case of the day is recommended.

If the anesthesia machine has been out of use or in storage, replace the absorbent before using the machine. Draeger Medical, Inc. recommends establishing a routine schedule with a sufficient safety margin for replacing the absorbent.


Remove accumulated absorbent dust and water from the absorber dust cup.

WARNING: Absorbent is caustic and is a strong eye, skin, and respiratory tract irritant. When emptying the absorber dust cup, take care not to spill is caustic contents.

NOTE: When changing the CO₂ absorbent, take care not to chip or crack the absorbent canister. Check the canister for signs of damage, especially around the rim, before reinstallation.

4. Close the vaporizer and flow control valves. Check for free gas passage in the patient breathing system. Wear a surgical mask to inhale and exhale through the breathing system (each limb individually if possible). Verify the unidirectional flow in each limb and then reconnect the tubing.

APL Valve

5.  Check the APL valve. The APL valve must be capable of relieving excess gas from the breathing system into the scavenger system.

To check the APL valve's flow resistance:


- a. Set the manual/automatic selector valve to BAG.
- b. Remove the bag from the bag mount.
- c. Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm hose.

- d. Completely open the APL valve by turning the control knob fully counterclockwise to its stop position.
- e. Turn the SYSTEM POWER switch to ON.
- f. Open the oxygen flow control valve to a flow of 8 l/min.
- g. Occlude the bag mount opening and watch for a pressure increase on the breathing system pressure gauge. This pressure increase must not exceed 3 cmH₂O.

**Breathing
System Leak
Test**

- 6. Perform a breathing and fresh gas delivery system pressure test. This test detects leaks from the patient breathing system and fresh gas delivery system.
To perform the test:
 - a. Close all flow control valves on the anesthesia machine.
 - b. Turn the SYSTEM POWER switch to the STANDBY position.
 - c. Turn the vaporizers to 0% concentration.
 - d. Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm breathing hose.
 - e. Set the manual/automatic selector valve to BAG.
 - f. Close the APL valve by turning the knob fully clockwise to its stop position.
 - g. Check that the breathing pressure gauge is on 0.
 - h. Attach the supplied test terminal to the breathing bag mount.
 - i. Connect a sphygmomanometer squeeze bulb (available from Draeger Medical, Inc.) to the hose barb on the test terminal.
 - j. Pump the squeeze bulb by hand until the breathing system pressure gauge indicates pressure of at least 50 cm H₂O (not to exceed 80 cm H₂O).

Scavenger System


- k. Observe the pressure drop at the breathing system pressure gauge. When the pressure is at 50 cmH₂O, begin counting seconds. Thirty seconds or longer are needed for a pressure drop from 50 to 30 cmH₂O.
7.  Verify the performance of the scavenger system.
To test negative pressure relief:
 - a. Connect a 19 mm scavenger hose to the ventilator relief valve and the scavenger interface.
 - b. Connect a 19 mm scavenger hose between the APL valve and the scavenger interface.
 - c. Connect the 3.0 liter reservoir bag to the reservoir bag terminal.
 - d. Connect the scavenger to the suction waste gas disposal system.
 - e. Short circuit the absorber's inspiratory and expiratory valves with a 22 mm breathing hose.
 - f. Set the absorber's manual/automatic selector valve to BAG.
 - g. Turn the APL valve fully counterclockwise.
 - h. Verify that the suction waste gas disposal system is active.
 - i. Open the scavenger needle valve enough to allow typical suction through the scavenger.
 - j. Close all flow control valves on the anesthesia machine.
 - k. Occlude the absorber breathing bag mount. At this point, the breathing pressure gauge should indicate a negligible negative pressure no lower than -1.0 cmH₂O.
To test positive pressure relief:
 - a. Connect a 19 mm scavenger hose to the ventilator relief valve and the scavenger interface.
 - b. Connect a 19 mm scavenger hose between the APL valve and the scavenger interface.
 - c. Connect the 3.0 liter reservoir bag to the reservoir bag terminal.

- d. Connect the scavenger to the suction waste gas disposal system.
- e. Short circuit the absorber's inspiratory and expiratory valves with a 22 mm breathing hose.
- f. Set the absorber's manual/automatic selector valve to BAG.
- g. Turn the APL valve fully counterclockwise.
- h. Verify that the suction waste gas disposal system is active.
- i. Turn the PEEP valve control knob fully counterclockwise to its lowest setting.
- j. Turn the scavenger needle valve fully counterclockwise.
- k. Push the O₂ flush button to inflate the scavenger reservoir bag.
- l. Open the oxygen flow control valve to a flow of 8 l/min.
- m. Occlude the absorber breathing bag terminal. The oxygen flow should exit through the positive pressure relief valve. The pressure gauge should indicate pressure less than 10.0 cmH₂O.
- n. Adjust the scavenger needle valve to a proper initial setting.

To test the scavenger interface for passive systems:

- a. Make sure a 19 mm scavenger hose is connected between the ventilator relief valve and the scavenger interface.
- b. Make sure a 19 mm scavenger hose is connected between the APL valve and the scavenger interface.
- c. Make sure a 19 mm scavenger hose is connected between the bottom scavenger interface and the hospital exhaust system.
- d. Check for moisture accumulation in the breathing and scavenger hoses. Remove any moisture found.
- e. Short-circuit the absorber's inspiratory and expiratory valves with a 22 mm breathing hose.

**Manual and
Automatic
Ventilation
Systems**

- f. Set the absorber's manual/automatic selector valve to AUTO.
 - g. Turn the PEEP valve control knob fully counterclockwise to its lowest setting.
 - h. Open the oxygen flow control valve to a flow of 10 L/min and occlude the 19 mm scavenger terminal labeled EXHAUST.
 - i. After the ventilator bellows inflates, the flow of oxygen exits the system through the positive pressure safety relief valve. At this point, the absorber system's breathing pressure gauge must indicate a pressure of less than 5 cm H₂O.
 8.  Test the ventilator.
 - a. Check for proper pressure and flow at the Y-piece during the inspiratory and expiratory phases. Turn the SYSTEM POWER switch and ventilator power switch to their ON positions. Place the manual/automatic selector valve in the AUTO position. Adjust the oxygen flow control valve to a 3 l/min flow. Set the ventilator frequency to 3 BPM, the I:E ratio to 1:2, and the tidal volume to about 1 liter.


Adjust the ventilator flow control to the maximum of the "low" zone on the flow gauge. Occlude the patient side of the Y-piece. Fill the ventilator bellows by pressing the oxygen flush button. Observe the breathing system pressure gauge as the ventilator cycles.

The pressure gauge must indicate a pressure over 30 cm H₂O when the bellows completes its downward travel. At the end of the expiratory phase, when the bellows completes its upward travel, the pressure should not exceed 3 cmH₂O.
 - b. Verify the PEEP valve's performance. Attach a breathing bag to the patient Y-piece with an appropriate adapter such as an NAD combination mask elbow with a 22 mm male fitting for the breathing bag and 15 mm male fitting for the Y-piece. With the manual/automatic selector valve in the AUTO position, set the ventilator to the preferred frequency.

Then adjust the PEEP valve to different values and observe the breathing system pressure gauge to verify performance. Turn the PEEP valve control knob fully counterclockwise to its lowest setting after the test is completed.

Daily and Preuse Checkout Procedures

6

- | | |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Monitor | <p>9. Check the alarm limit settings. The monitor alarm limits set automatically to a default configuration when the SYSTEM POWER switch is turned on. Check these settings and adjust them if necessary. Alarm limits may be adjusted at the beginning of or during a procedure. Also, make sure that any external monitors are connected properly and that the alarms sound through the anesthesia machine's central audio annunciator.</p> <p>10.  Test the alarm functions of all monitors. Simulate alarm conditions and check for appropriate alarm signals.</p> |
| System Flush | <p>11. Flush the system with 100% oxygen by pressing the oxygen flush button.</p> |
| Final Position | <p>12. At the completion of the checkout procedure, verify that:</p> <ul style="list-style-type: none"> a. the vaporizer is off (handwheel is set to zero) b. the vaporizer is filled to the maximum fill line c. the APL Valve is open (fully counterclockwise) d. the manual/automatic switch is set to BAG e. all flowmeters indicate 0 (or minimum) f. the patient suction level is adequate g. the breathing system is ready to use (bag is in place and all hoses connected are properly). |

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Operating the Anesthesia Machine

Gas Delivery System Operation

The Narkomed M is a continuous flow anesthesia system with pneumatic circuitry for mixing and delivering fresh gas and anesthetic agent vapor. The pneumatic system can deliver up to three gases (oxygen, nitrous oxide, and air) and one anesthetic agent (isoflurane) simultaneously.

Adjusting the Gas Flow

To adjust the gas flow:

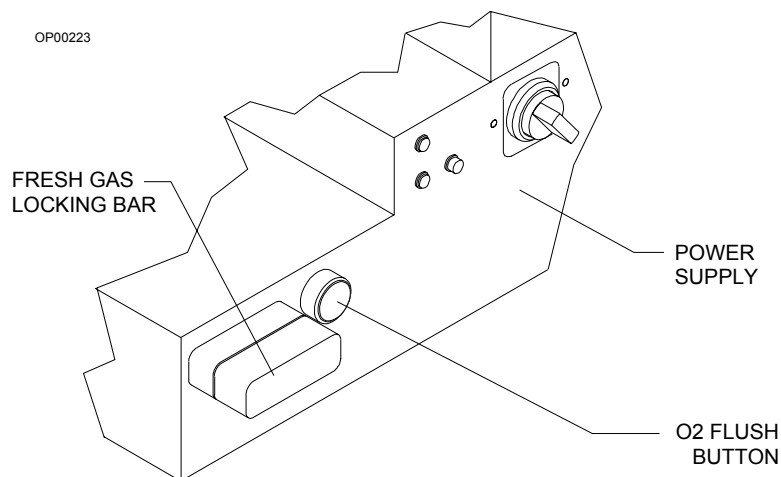
1. Turn the flow control knob located below the flowmeter tube for the gas you want to adjust. Turning the valve knob counterclockwise increases flow. Turning the knob clockwise decreases flow.
2. As you adjust the flow control knob, observe the flow rate. Flow rate is indicated by the flowmeter scale reading at the center of the float.

CAUTION: The oxygen flow cannot be completely shut off. Do not force the oxygen flow control knob past the zero-stop in an effort to shut off the minimum flow. Forcing the knob can damage the valve seat.

Using the Oxygen Flush

To use the oxygen flush, press the oxygen flush button, located on the front of the Narkomed M. This introduces an unmetered flow of pure oxygen into the breathing circuit at a rate of about 55 L/min.

Figure 7-1. Oxygen Flush Button



Anesthetic Vaporizer Operation

The Dräger-Vapor 2000 adds an anesthetic gas to the fresh gas stream by producing a precisely metered amount of the vapor of a particular liquid anesthetic. The vaporizer is installed in the fresh gas line upstream of the patient breathing system (semi-closed, semi-open system). Refer to the *Dräger-Vapor 2000 Anaesthetic Vaporiser Instructions for Use* for detailed information about operating the vaporizer.

WARNING: The vaporizer must not be connected downstream of the fresh gas outlet of the anesthesia machine.

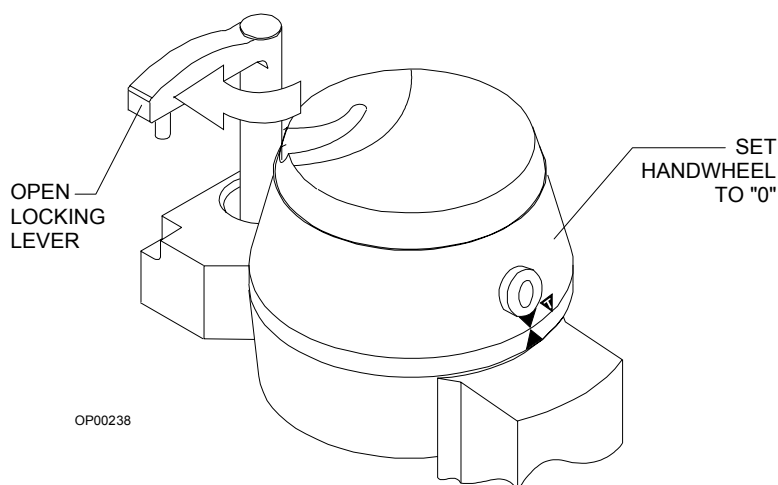
For low flow (fresh gas flows lower than 250 mL/min) or closed system anesthesia, breathing circuit concentrations may differ considerably from the vaporizer setting. When performing anesthesia with low flow or closed system techniques, it is essential to monitor inspiratory and expiratory anesthesia concentration, oxygen concentration, expiratory volume, and airway pressure in the circuit.

WARNING: Be sure to fill the vaporizer in an upright position. Filling the vaporizer in a tilted position can cause overfilling. Overfilling causes the anesthetic concentration rate to be higher or lower than the handwheel setting.

Before each case, perform the preuse checkout procedures and check the following:

1. Make sure the drain valve is closed.
2. Set the handwheel to 0 (zero-point interlock) and make sure the button is engaged. If the handwheel is set to T, open the locking lever on the plug-in system. Then press the 0 button and turn the handwheel to 0 and engage the button. Wait 5 seconds for the pressure to equalize.

Figure 7-2. Locking Lever Open/Handwheel Moved to Zero



3. Fill the vaporizer to the maximum fill line.
4. Replace and tighten the sealing plug.

**Turning the
Vaporizer On**

To turn the vaporizer on:

1. Adjust the fresh gas flow.
2. Turn the vaporizer handwheel to the preferred anesthetic concentration. Do not set the handwheel between 0 and 0.2% volume concentration. This part of the handwheel actuates the on/off switch and cannot be calibrated.

NOTE: After turning on the vaporizer, activate the scavenger system to collect and remove vented gas from the operating room.

**Turning the
Vaporizer Off**

To turn the vaporizer off, turn the vaporizer handwheel to 0 (zero-point interlock) and make sure the button engages. Do not interrupt the fresh gas flow until the vaporizer is turned off.

NOTE: Drain the anesthetic agent if the vaporizer will not be used for longer than six months or if the vaporizer will be removed from the anesthesia machine.

**Filling the
Vaporizer
During a
Case**

Be extremely careful when filling the vaporizer during a case. The vaporizing chamber is pressurized when fresh gas is flowing and the vaporizer is turned on.

To safely add anesthetic agent while the machine is in use, depressurize the vaporizer by setting the handwheel to 0 (zero-point interlock). Make sure the button engages in the locked position. Allow at least 5 seconds for the vaporizing chamber to depressurize, then add the anesthetic agent.

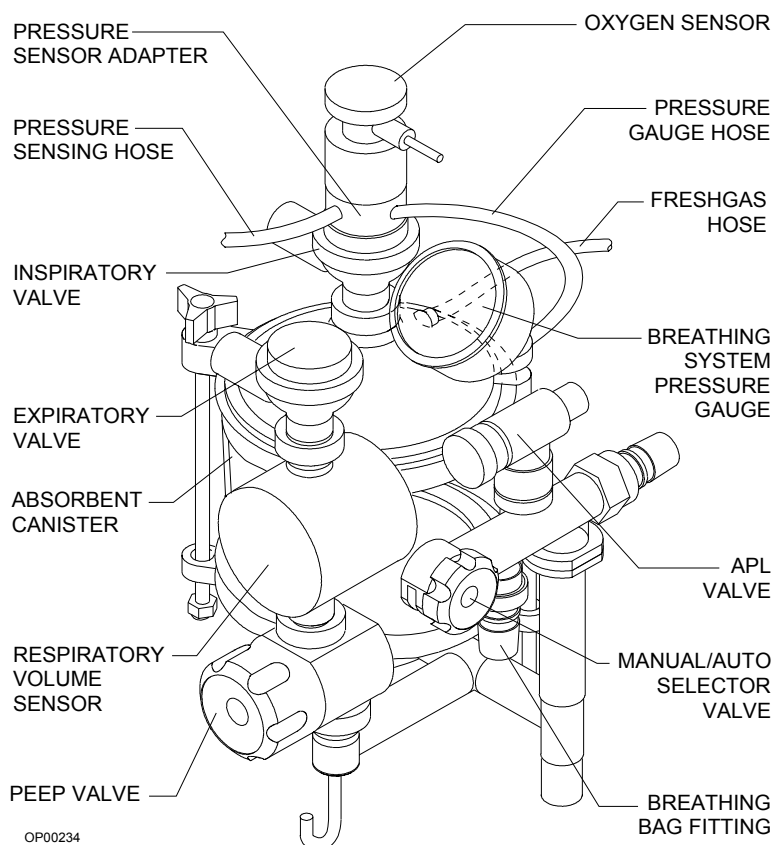
WARNING: The vaporizer handwheel must be set to 0 (zero-point interlock) before the vaporizer can be filled. If the vaporizer is not depressurized before unsealing the filling spout, liquid anesthetic can gush out.

WARNING: Because the vaporizer funnel filling system does not limit the type of agent poured into the vaporizer, using an agent monitoring device is recommended to verify the agent.

Absorber System Operation

A single-canister system absorbs exhaled carbon dioxide in the rebreathing circuit of the anesthesia machine.

Figure 7-3. Absorber System



The absorber system includes:

- an inspiratory valve and an expiratory valve
- an absorber canister and dust cup
- a breathing system pressure gauge
- a pressure sensing hose assembly
- fresh gas hose
- manual/automatic ventilation selector valve
- an adjustable pressure limiter (APL) valve
- respiratory volume sensor
- oxygen concentration sensor

- a positive end-expiratory pressure (PEEP) valve.

The absorber system handles spontaneous, manually assisted, or automatic ventilation. The preferred mode of operation is selected with the manual/automatic selector valve.

WARNING: Waste gas scavenging systems used with Draeger Medical, Inc. absorber systems must have safety features to ensure that excessive subatmospheric pressure (lower than -0.5 cmH₂O) and excessive positive pressure (higher than +5.0 cmH₂O) are not possible at the connection point.

Using the Manual/Automatic Selector Valve

The manual/automatic selector control knob must be positioned properly for either the ventilator bellows or the breathing bag to be properly engaged in the breathing circuit. Turn the knob counterclockwise for the BAG setting. Turn the knob to the clockwise for the AUTO setting. The settings are labeled on the control knob. The current setting appears near the top.

Set the knob to BAG for spontaneous breathing or manually assisted ventilation. Set the knob to AUTO for automatic ventilation.

Selecting the ventilator (AUTO) pathway removes the APL valve and the breathing bag from the active gas pathway of the absorber. When the system is set in the automatic mode, excess gas is relieved from the breathing circuit through a relief valve mounted on the ventilator bellows.

Selecting BAG eliminates the ventilator and its relief valve from the active gas pathway and includes the APL valve and breathing bag. In this mode, the breathing bag acts as a passive reservoir for breathing gases and the patient's thoracic movements drive the gases through the breathing circuit. When breathing is manually assisted, the breathing bag contains breathing gases and functions as the sole means of driving them through the breathing circuit when the bag is squeezed.

WARNING: Do not use the inspiratory or expiratory valves if

- the pin in the valve domes or valve body is bent damaged, or missing,
- the valve disks are missing or damaged, or
- the valve seat is damaged.

**Using the
APL Valve**

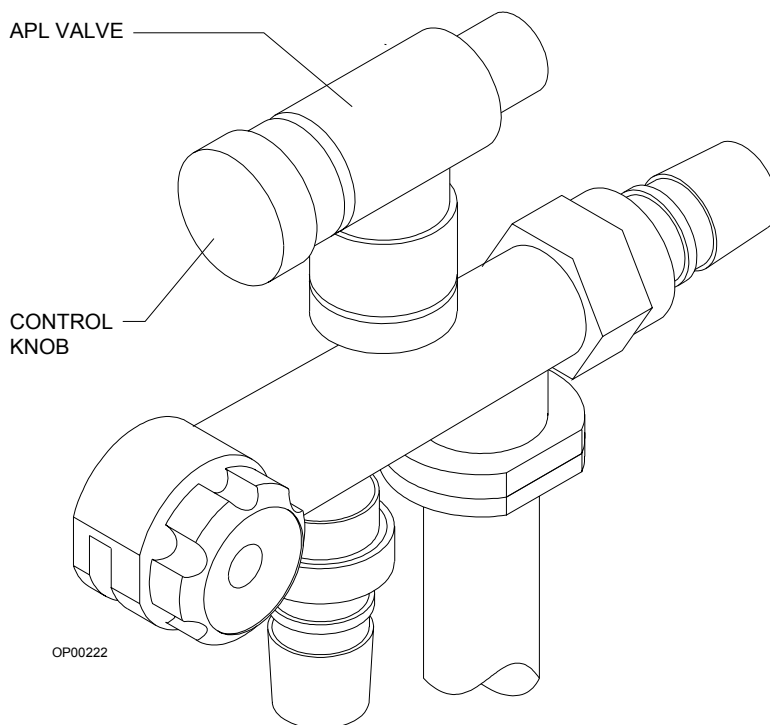
The APL valve relieves excess gas from the breathing circuit into the scavenger system during spontaneous or manual ventilation. The APL valve expels excess gas containing expired carbon dioxide before it contacts the absorbent, which extends the life of the absorbent.

Turning the APL valve knob clockwise increases the flow resistance into the scavenging system. Complete clockwise rotation eliminates all flow through the valve. Turning the knob counterclockwise decreases the flow resistance.

In addition to regulating the amount of waste gas flow, adjusting the APL valve also affects the patient peak inspiratory pressure during manual ventilation. Turning the APL valve knob counterclockwise reduces the valve's flow resistance and lowers the peak inspiratory pressure. Turning the APL valve knob clockwise increases the valve's flow resistance and raises the peak inspiratory pressure. However, a variety of additional factors, such as fresh gas flow rate and the method used to squeeze the breathing bag, also affect patient peak inspiratory pressure during manual ventilation.

During spontaneous ventilation, the APL valve control knob must be fully open (turned fully counterclockwise) to minimize mechanical resistance to patient exhalation.

Figure 7-4. APL Valve



A gravity-loaded check valve within the APL valve prevents gas flow from the scavenging system into the breathing system. For instance, during spontaneous ventilation when patient inspiratory effort produces a negative pressure on the breathing circuit side of the check valve, the valve closes and prevents gas from the scavenger system from entering the breathing circuit. Also, the check valve minimum opening pressure of about 1 cmH₂O enables the breathing bag to reinflate before the valve opens.

WARNING: To minimize mechanical resistance to the patient's exhalation during spontaneous breathing, the APL valve's control knob must be turned fully counterclockwise. For manually assisted or manually controlled ventilation, APL valve resistance must be increased as needed by turning the APL valve control knob clockwise.

**Using the
PEEP Valve**

The absorber system regulates positive end-expiratory pressure (PEEP) through the PEEP valve. The PEEP valve is located on the absorber downstream of the breathing system pressure gauge. As a result, the pressure gauge reading includes PEEP. Its integral design also prevents accidents that are possible with accessory PEEP valves, such as inadvertent reversal and misplacement in the inspiratory limb.

Turning the PEEP control knob clockwise increases PEEP, and turning the knob counterclockwise reduces PEEP. The actual PEEP in the system is indicated on the absorber pressure gauge at the end of exhalation and can be adjusted from about 2 to 15 cmH₂O.

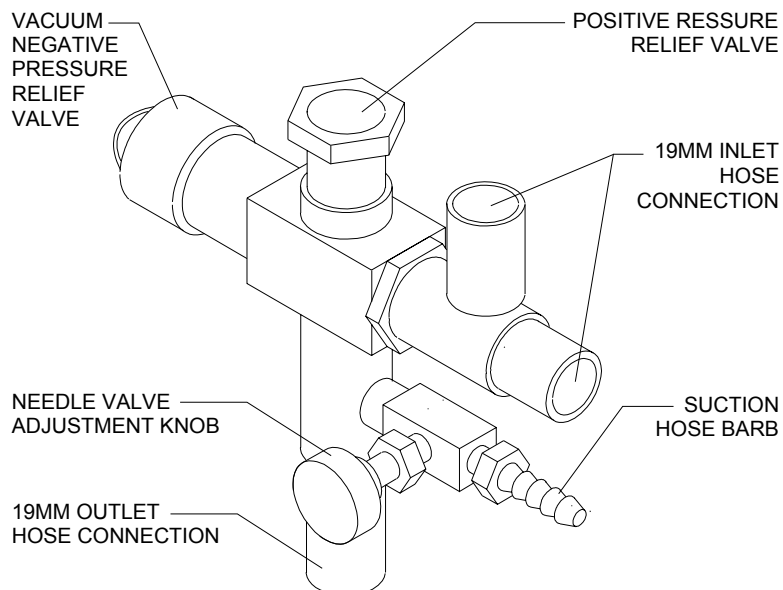
Scavenger Interface Operation

The scavenger interface is an exhaust collector manifold. It is intended for use with suction (vacuum) or passive waste gas disposal systems.

The suction approach uses continuous suction to transfer the gas from the scavenger to the disposal system. Passive systems rely on the pressure of the waste gas to convey the waste gas to the exhaust system.

This is a closed system that has one spring-loaded valve for positive pressure relief and one for negative pressure relief.

Figure 7-5. Scavenger Interface



OP00228

WARNING: The scavenger interface for suction systems requires proper adjustment for safe operation. The needle valve regulates the waste gas exhaust flow. During a case, the needle valve must be readjusted as needed. Needle valve adjustment depends on several factors, including the fresh gas flow rate and type of suction disposal system.

WARNING: The positive pressure relief valve must be inspected and cleaned (if necessary) at six month intervals.

WARNING: Waste gases vented through the positive pressure relief valve enter the operating room. Properly adjusting the needle valve keeps such venting to a minimum.

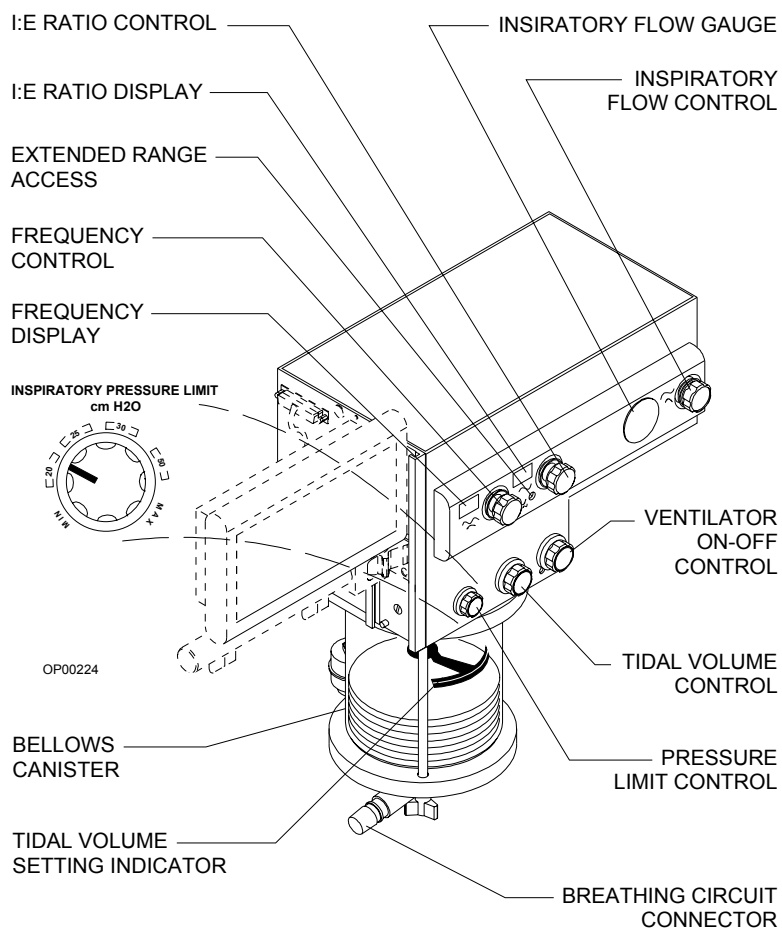
**Needle Valve
Adjustment
for Suction
Systems**

1. Attach breathing hoses and a Y-piece to the absorber system.
2. Attach a breathing bag to the Y-piece, using an appropriate adapter such as an NAD combination mask elbow with a 15 mm male fitting for the Y-piece and a 22 mm male fitting for the breathing bag.
3. Set the manual/automatic selector valve to AUTO and set the ventilator to the preferred frequency.
4. Adjust the O₂ flow control valve to the expected total flow of all gases.
5. Verify that the suction disposal system is active.
6. Watch the scavenger reservoir bag as the oxygen flow passes through the scavenger. The bag should not overextend or collapse.
7. Adjust the needle valve to provide either more or less suction.

Anesthesia Ventilator Operation

The anesthesia ventilator is a volume preset, time cycled, pressure limited ventilator with electronic timing, pneumatic circuitry and independent controls for frequency, inspiratory to expiratory (I:E) ratio, inspiratory flow rate, tidal volume, and inspiratory pressure limit.

Figure 7-6. Anesthesia Ventilator Components and Controls



Pneumatic power (bellows drive gas) to the ventilator is supplied through the hospital pipeline supply or through reserve cylinders on the anesthesia machine. A switch on the side of the machine allows the use of either oxygen or air as the drive gas. The pressure of the supply gas must be between 40 and 60 psi. The ventilator will not function if this pressure drops below 32 psi. Electrical power is supplied by the Narkomed M's AC power source, or, in event of AC power failure, by the backup battery. A fully charged battery can power the ventilator for at least 90 minutes.

The anesthesia ventilator is designed for use with a Draeger Medical, Inc. absorber system, which incorporates a manual/automatic selector valve. This valve allows you to select either the breathing bag and adjustable pressure limiter (APL) valve for manual ventilation, or the ventilator bellows for automatic ventilation.

During automatic ventilation, the manual/automatic selector valve isolates the absorber's APL valve from the breathing system. To compensate for the continuous introduction of fresh gas into the breathing system, the ventilator incorporates a relief valve mounted behind the bellows chamber.

When the bellows is completely filled, any excess gas in the system is released to the scavenging system through the ventilator relief valve. As in any ascending bellows, the force needed to overcome gravity acting on the bellows causes a positive end-expiratory pressure (PEEP) within the breathing system. The PEEP is approximately 2 cmH₂O.

The monitoring system's breathing pressure and expiratory flow waveform displays can be used as an aid in adjusting the ventilator and establishing alarm criteria.

WARNING: Regardless of the indications of any alarm or monitoring device, patient chest movement shall be the primary indication of a securely connected, properly ventilated patient.

Activating the Ventilator

The ventilator is activated by using the ventilator on/off control. The anesthesia machine's SYSTEM POWER switch located at the bottom of the flowmeter housing must be set to ON for the ventilator to function.

Using the Ventilator On/Off Control

The ventilator power switch controls the pneumatic and electrical power to the ventilator. In the OFF position, the FREQUENCY and I:E RATIO displays remain lighted, but the ventilator will not function. The ON position activates the ventilator. The monitoring

system's volume and pressure alarms are automatically enabled when the power switch is in the ON position.

Adjusting the Tidal Volume

The tidal volume is adjusted using a self-locking knob, located above the bellows assembly. The control knob positions a stop within the bellows canister that limits the upward travel of the bellows and sets the maximum tidal volume of gas delivered to the patient.

To adjust the tidal volume, press the self-locking knob in so it can turn, then set the tidal volume by the setting indicator on the bellows chamber scale (marked 200–1400 ml). The tidal volume can be adjusted for volumes between 50 and 1500 ml.

Smaller tidal volumes can be adjusted by setting the pointer below the 200 ml marking on the bellows chamber. Larger tidal volumes can be selected by setting the pointer above the 1400 ml calibration.

As in any volume-preset anesthesia ventilator, the actual tidal volume delivered to the patient's lungs may differ from the preset volume at the bellows due to the compliance of the breathing system and fresh gas flow. To accurately set the tidal volume, refer to the tidal and minute volume measurements.

The position of the tidal volume indicator can be calibrated for a specific combination of fresh gas flow and equipment compliance by a qualified technical service representative.

Setting the Respiratory Frequency

Use the frequency control knob to set the respiratory frequency from 1 to 99 breaths per minute (BPM) in 1 BPM increments.

Clockwise rotation of the control knob increases the frequency setting, while counterclockwise rotation decreases the frequency setting.

Setting the Inspiratory/Expiratory (I:E) Phase Time Ratio

Use the I:E ratio control knob to set the inspiratory/expiratory (I:E) phase time ratio. The standard range of ratios is from 1:1 through 1:4.5, adjustable in increments of 0.5.

An extended range of ratios is also available that allows the setting of inverse I:E ratios. The specific extended range settings are: 4:1, 3:1, and 2:1. The extended range settings are accessible by pressing the EXTENDED RANGE switch while rotating the I:E ratio control knob.

Clockwise rotation of the control knob increases the I:E ratio setting, while counterclockwise rotation decreases the I:E ratio setting.

WARNING: Using inverse I:E ratios will introduce auto-PEEP.

Setting the Inspiratory Flow Rate

Use the inspiratory flow control knob to set the inspiratory flow in the range of 10 L/min to 100 L/min. This setting controls the flow rate of gas into the bellows canister, affecting the flow rate of gas delivered to the patient.

Because of patient circuit variables such as lung compliance, fresh gas flow, airway resistance and equipment compliance, the flow gauge is labeled with nominal zones of LOW, MEDIUM, and HIGH.

Adjust the flow setting to a point where the ventilator bellows is fully compressed (but not deformed) at the end of the inspiratory phase of the breathing cycle.

The inspiratory flow control can be used to create an inspiratory plateau at the end of the inspiratory cycle and to affect the potential peak inspiratory pressure within the patient breathing system. Always check the pressure indicated by the breathing system pressure gauge and waveform when adjusting the inspiratory flow control.

Setting the Inspiratory Pressure Limit

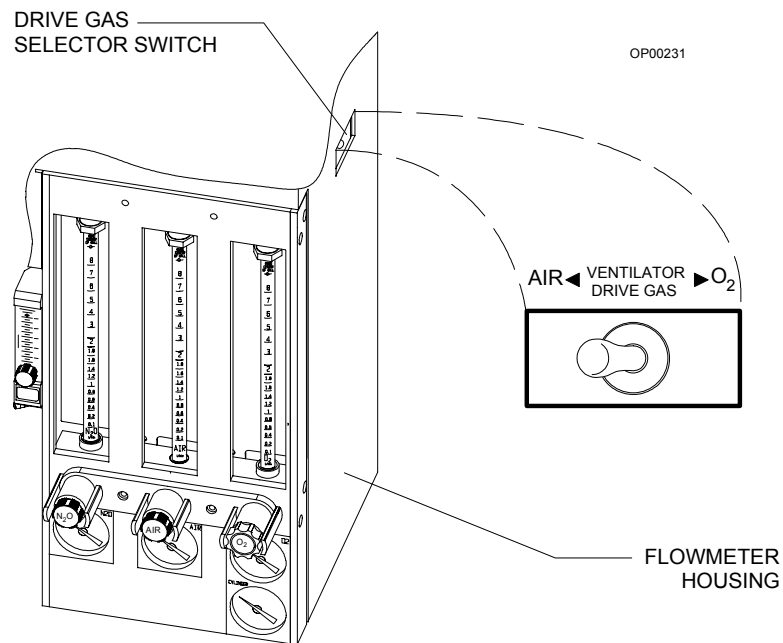
The pressure limit control, located above the bellows canister, is used to adjust the pressure limit over a scale labeled with nominal zones of MIN-20-25-30-50-MAX. This control determines the maximum pressure that can be delivered by the ventilator during the inspiratory phase of the respiratory cycle. Because of patient circuit variables, the scale is only a reference. The pressure should be read from the breathing system pressure gauge or the anesthesia machine's pressure monitoring system.

When the pressure limit control is turned fully counterclockwise, the peak inspiratory pressure is less than or equal to 15 cmH₂O. When the control is turned fully clockwise, the peak inspiratory pressure is less than or equal to 120 cmH₂O.

**Selecting the
Bellows
Drive Gas**

A toggle switch located on the side of the flowmeter housing is for selecting the bellows drive gas. To select oxygen as the drive gas, move the switch to the O₂ position. to select air as the drive gas, move the switch to the Air position.

Figure 7-7. Drive Gas Selector Switch



Using the Monitoring System

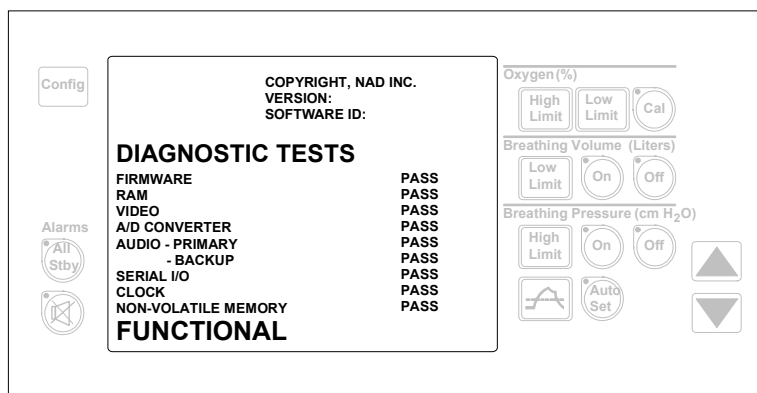
Overview

In addition to monitoring clinical parameters, the Narkomed M performs diagnostic self-tests every time the machine is turned on. After the initial power-on screen appears, the Monitor screen is displayed. This section of the manual describes these screens, and explains how to establish general monitoring settings.

Power-On Screen

When you turn the SYSTEM POWER switch ON, the Narkomed M performs extensive self-tests on its internal hardware. As these diagnostics are performed, each test and its result appear on the screen. The result, PASS or FAIL, indicates the status of the tested component.

Figure 8-1. Power-On Screen



OP00215

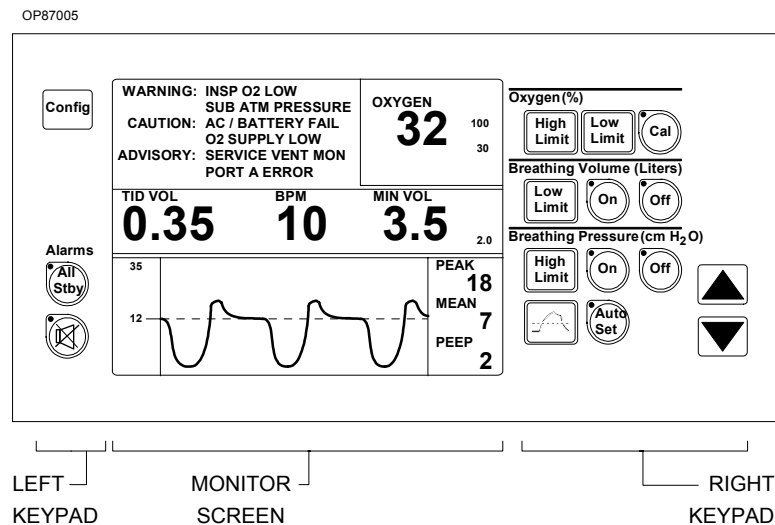
At the end of the self-diagnostics, one of three possible conclusions to the self-tests is posted on the screen:

FUNCTIONAL	The monitoring system is in satisfactory operational order. After a brief delay, the Monitor screen appears.
CONDITIONALLY FUNCTIONAL	A noncritical fault was detected, such as a speaker failure. The Narkomed M may be used, but a qualified technical service representative should be notified to correct the problem. When you are ready to resume operation, press any key on the keypad.
NONFUNCTIONAL	A serious fault was detected and operation of the monitor is inhibited. Do not use the machine. Immediately notify a qualified technical service representative to correct the problem.

Monitor Screen and Controls

Following a successful power-up, monitoring information is displayed on the Monitor screen. The control keys to the left and right of this screen allow you to establish monitoring settings.

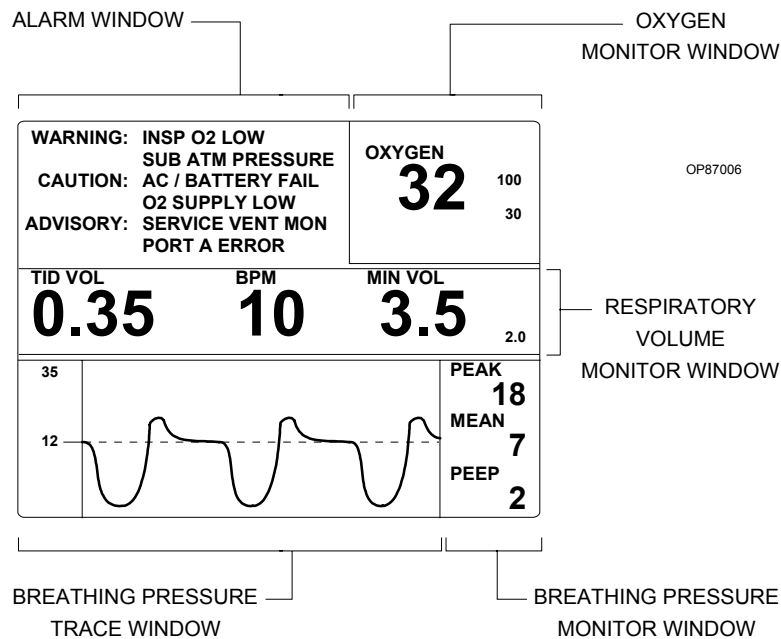
Figure 8-2. Monitor Screen and Controls



Monitor Screen

The Monitor screen displays information in five separate windows.

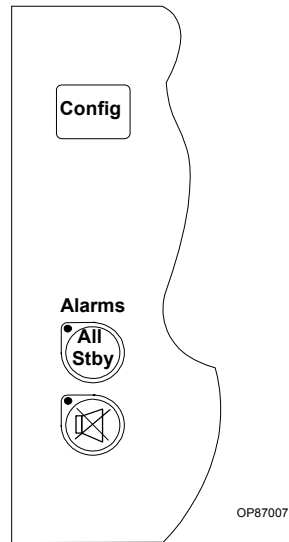
Figure 8-3. Monitor Screen Window Locations



- **Alarm Window**—Displays up to six of the highest priority alarms.
- **Oxygen Monitor Window**—Displays the patient's oxygen concentration and the anesthesia machine's oxygen alarm limits.
- **Respiratory Volume Monitor Window**—Displays the patient's tidal volume, respiratory rate (breaths per minute), and minute volume, as well as the anesthesia machine's minute volume low alarm limit.
- **Breathing Pressure Monitor Window**—Displays the patient's peak airway pressure, mean airway pressure, and positive end expiratory pressure (PEEP).
- **Breathing Pressure Trace Window**—Displays a trace, or waveform, of the patient's breathing pressure, and the anesthesia machine's breathing pressure alarm limits (to the left of the waveform).

Left Keypad You use the left keypad to initiate system-wide monitoring functions.

Figure 8-4. Left Keypad



All Standby

When the ventilator is off, turns off audible tones and message displays associated with the breathing pressure alarm and respiratory volume alarms, until a valid breath is detected.



Silence Alarms

Silences all audible alarm tones for 2 minutes.



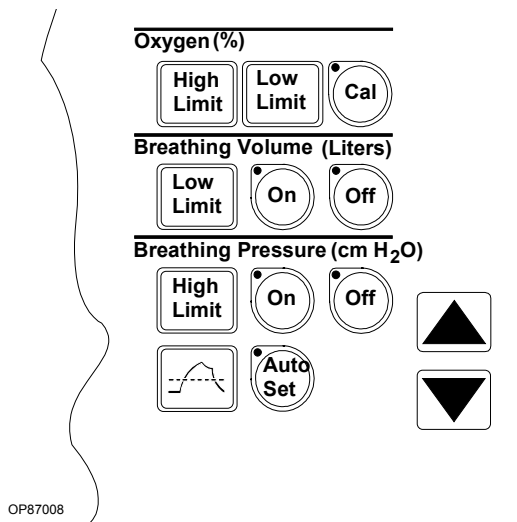
Configure

Displays the Configure screen, where you can set system parameters, such as the time, date, and alarm volume. You also enter the Alarm Log by way of the Configure screen.

These functions are described in detail later in this section.

Right Keypad You use the right keypad to perform functions associated with a specific monitor. These functions are described in the following sections: “Oxygen Monitoring,” “Respiratory Volume Monitoring,” and “Breathing Pressure Monitoring.”

Figure 8-5. Right Keypad



Configuring the Anesthesia Machine

You can configure the following parameters on the Narkomed M:

- **Trace Speed**—Speed of the breathing pressure waveform trace: either FAST or SLOW
- **Alarm Volume**—Volume of annunciated alarms
- **Current Time**—The current hour and minute in 24-hour format (*hour:minute*)
- **Current Date**—The current day, month, and year
- **Display Alarms**—On/Off status of the anesthesia machine's Alarm window.

The Display Alarms parameter is configurable only when the anesthesia machine is connected to another Narkomed product that can display the anesthesia machine's alarms on a central alarm display. An On status indicates that the anesthesia machine's Alarm window will continue to display alarms as usual. An Off status indicates that the anesthesia machine's Alarm window will not display alarms; instead, alarms will be displayed on the other product's central alarm display.

When you start the anesthesia machine, it uses the values that were established the last time the machine was configured. You can view or change these values on the Configure screen.

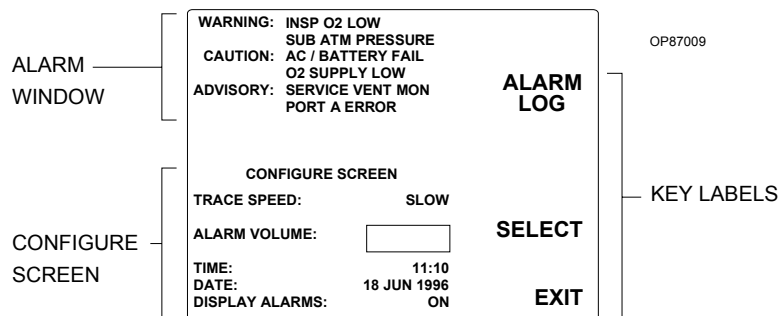
Displaying the Configure Screen

To display the Configure screen, press the Config key, which is located on the left keypad.





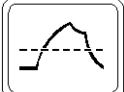
The Configure screen replaces the standard Monitor screen. You must begin configuration within 1 minute, or the Monitor screen will replace the Configure screen.

Figure 8-6. Configure Screen



Understanding the Keys

When the Configure screen is displayed, the system control keys function according to the labels on the screen.

Key	Label	Function
	ALARM LOG	Displays the Alarm Log, a separate screen that lists cautions and warnings that have occurred
	SELECT	Selects a parameter by highlighting it with a box
	EXIT	Exits the Configure screen and returns to the Monitor screen

Changing Parameter Values

Follow this procedure for each parameter you want to change.



1. Press the SELECT key until the variable you want to change is highlighted with a box.
2. Press the up or down arrow key to increase or decrease the value of the highlighted variable.

Exiting the Configure Screen

To exit the Configure screen immediately, press the EXIT key.

NOTE: The monitoring system automatically exits the Configure screen if a minute passes and no keys are pressed.



When you exit the Configure screen, the values displayed on the screen are saved. The monitoring system uses these values until they are changed.

Using the Alarm Log

If you miss a warning or caution message in the Alarm window, you can look for it in the Alarm Log. It contains up to 100 of the most recent warning and caution messages. When there are more than 100 warnings and cautions, the oldest message is deleted to make room for the newest.

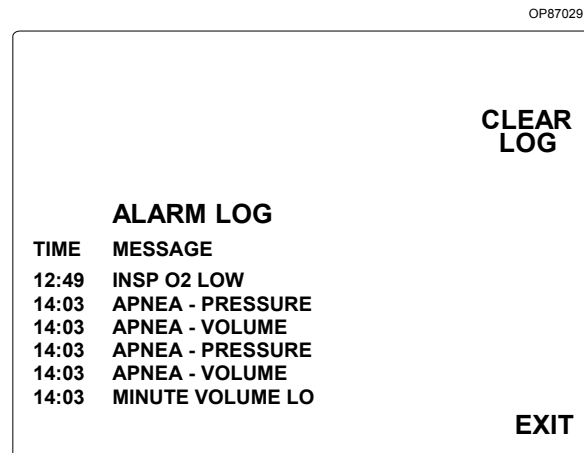
Displaying the Alarm Log

Follow this procedure to display the Alarm Log.



1. From the Monitor screen, press the Config key.
The Configure screen is displayed.
2. From the Configure screen, press the ALARM LOG key.
The Alarm Log appears, with the first warning or caution that occurred at the top of the list.
3. If the list extends beyond the page, scroll forward by pressing the down arrow key, and scroll backward by pressing the up arrow key.

Figure 8-7. Alarm Log Screen



Clearing the Alarm Log



To delete all of the messages from the Alarm Log, press the CLEAR LOG key.

The messages are permanently deleted from the LOG.

Exiting the Alarm Log



To exit the Alarm Log immediately, press the EXIT key.

NOTE: The monitoring system automatically exits the Alarm Log if a minute passes and no keys are pressed.

When you exit the Alarm Log, you return to the Monitor screen.

Setting Alarms to Standby



When the ventilator is off, you can use the All Stby key to turn off audible tones and message displays associated with the breathing pressure alarm and respiratory volume alarms. The alarms remain in this standby condition until the monitor detects a valid breath.

NOTE: If the ventilator is on, setting alarms to standby has no effect on the pressure alarm. The pressure alarm cannot be turned off when the ventilator is on.

To set alarms to standby, press the All Stby key.

The LED next to the All Stby key lights to indicate the standby condition.

Silencing Alarms



You can silence all audible alarm tones for 2 minutes while retaining the alarm message display on the monitor.

To silence alarm tones for 2 minutes, press the Silence Alarms key.

The LED next to the Silence Alarms key lights and remains lit for the duration of the silence period. Pressing the Silence Alarms key while the LED is lit restarts the 2-minute silence period.

If a new alarm condition occurs during the silence period, a single tone pattern sounds corresponding to the priority of the alarm.

After the silence period, one of the following occurs:

- If no alarm conditions are active, audio annunciation reverts to normal.
- If any Warning or Caution conditions are active, the tone associated with the highest existing alarm condition sounds. The alarm continues to sound once every minute, for up to 3 minutes, or until alarm conditions have been cleared for 10 seconds.

NOTE: All continuous audible alarms are automatically silenced for 2 minutes following power-up. During this period, the occurrence of a new alarm produces a non-repeating tone pattern appropriate for that alarm's level of urgency.

Oxygen Monitoring

Inspiratory oxygen concentration is measured with a dual galvanic cell sensor, which is attached to the inspiratory valve dome. The sensor contains two independent electrochemical cells, or sensor halves. When the sensor takes in oxygen, an electrochemical reaction occurs within each cell. The oxygen monitor reads the voltage produced in each cell, computes an average for the two cells, and translates the average into an oxygen concentration measurement.

CAUTION: Never remove an oxygen sensor from its housing, except to replace it. If a sensor is removed from its housing, you must do the following before continuing normal operations:

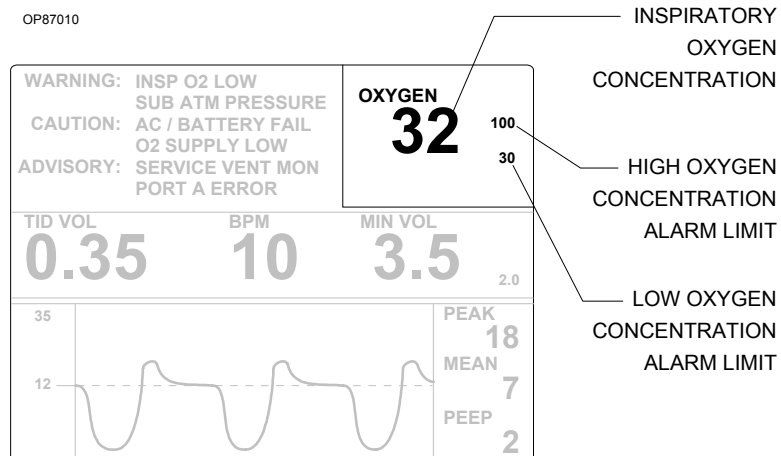
- Reinstall the sensor in the housing.
- Wait for a period equal to the time that the sensor spent outside the housing.
- Calibrate the sensor.

NOTE: When the machine is not in use, remove the oxygen sensor assembly from the inspiratory valve dome, and insert the inspiratory valve dome plug into the inspiratory valve dome.

Oxygen Monitoring Display

Information about the oxygen analysis is presented in the Oxygen Monitor window at the top right of the monitor display. The numerical value for inspiratory oxygen concentration is shown in large type. To the right of this figure, in small type, are the high and low oxygen concentration alarm limits.

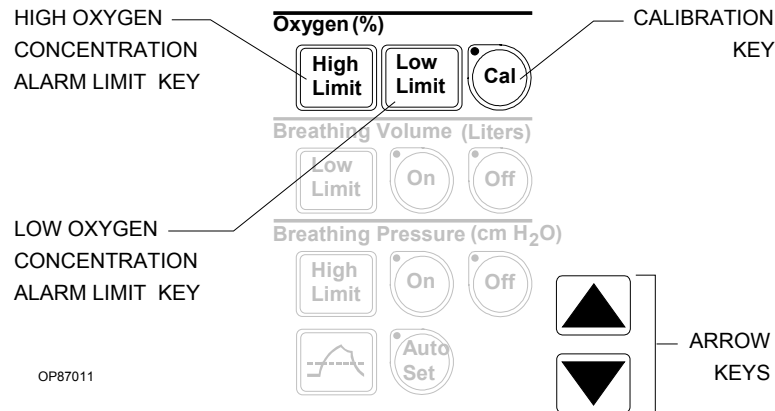
Figure 8-8. Oxygen Monitor Window



Oxygen Monitor Controls

You use the oxygen monitor control keys and the arrow keys on the right keypad to set oxygen concentration alarm limits and calibrate the oxygen sensor. The oxygen monitor control keys are located next to the Oxygen Monitor window.

Figure 8-9. Oxygen Monitoring Control Keys



Setting Alarm Limits



At power-up, the oxygen high and low alarm limits are automatically set to their system defaults. You can adjust these limits within specified ranges. Valid settings for the alarm limits, and their system defaults, are shown in the following table.

Alarm Limit	Default	Valid Settings
High	100%	19%–100%; must be greater than low alarm limit
Low	30%	18%–99%; must be less than high alarm limit

Follow these steps to change the high or low alarm limit:

1. Press the Oxygen High Limit or Low Limit key, depending on which alarm limit you want to change.
A box is drawn around the selected alarm limit.
2. Press the up arrow or down arrow key to increase or decrease the highlighted alarm limit.

3. To save the new value, stop pressing arrow keys until the highlighting box disappears (5 seconds), or press a different alarm Limit key.

The new value is saved as the alarm limit.

Calibrating the Oxygen Sensor



To calibrate the oxygen sensor correctly, make sure it is exposed only to room air during the entire calibration period. You should calibrate the oxygen sensor as part of the daily preoperative setup of the anesthesia equipment.

1. Remove the sensor assembly from the inspiratory valve dome and close off the dome with the inspiratory valve dome plug. (Do not disassemble the sensor assembly further.)
2. Expose the sensor to ambient air only (21% oxygen concentration) and allow it to stabilize for several minutes. To ensure an ambient air exposure, hold the sensor away from any open part of the breathing system.
3. With the sensor exposed only to room air, press the Cal key. Calibration begins.
4. View the monitor screens to track progress of the calibration.
 - During calibration, the LED next to the Cal key lights, and the label CAL appears in the Oxygen Monitor window.
 - Following successful calibration, the currently sensed oxygen concentration appears in the Oxygen Monitor window. (If the calibration was not successful, the Oxygen Monitor window is blank. See “Unsuccessful Calibration” in this section for further information.)

Typically, calibration lasts less than 30 seconds. However, the time may vary depending on the amount of oxygen the sensor was exposed to before calibration.

Oxygen Exposure	Typical Calibration Time
21%	10 seconds
> 21%	up to 50 seconds

5. When the Narkomed M successfully completes the calibration, pull the inspiratory valve dome plug and reinsert the sensor assembly.

Unsuccessful Calibration

If, at the end of the calibration period, if the Oxygen Monitor window is blank, the calibration was not successful. (This condition is also indicated by the CAL O2 SENSOR Advisory message in the Alarm window.)

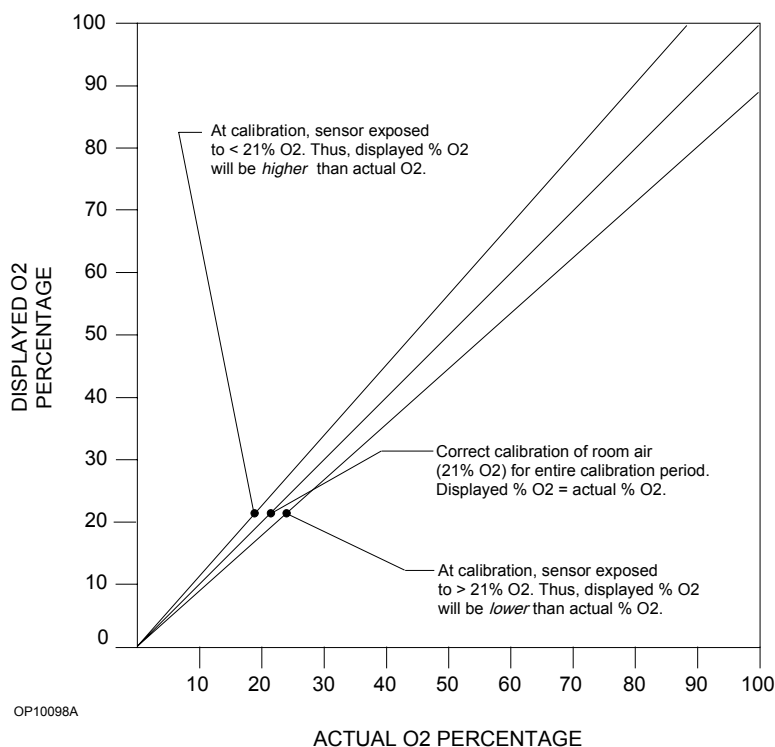
An unsuccessful calibration can be caused by several conditions.

Cause	Solution
Sensor was exposed to an excessively lean or excessively rich oxygen calibration mixture.	Make sure that the sensor is exposed to room air only for the entire calibration period.
Sensor was exposed to a constantly changing calibration mixture.	Make sure that the sensor is exposed to room air only for the entire calibration period.
Sensor did not receive the proper waiting period.	If the sensor capsule was removed from the sensor assembly, a waiting period equal to the time that the capsule spent outside the sensor assembly (up to one week) is necessary prior to calibration. New sensors require a 15-minute waiting period.
Sensor is exhausted.	If the oxygen sensor has decayed beyond its useful service life (see the "Specifications" section of the manual), replace the decayed sensor with a new sensor and allow the proper waiting period.
Sensor failure.	If there is too great a difference between the outputs of the two sensor halves, replace the failed sensor with a new sensor, and allow the proper waiting period prior to calibration.
Sensor is disconnected.	When the sensor is disconnected, the display area is blank, and the message O2 SENSOR DISC appears in the Alarm window. If this happens, reconnect the sensor cord to the OXYGEN SENSOR interface beneath the rear panel of the ventilator box and try to calibrate the oxygen sensor again.

If the oxygen sensor is improperly calibrated, it can cause inaccurate measurements. When a calibration gas mixture is excessively rich or lean in oxygen, the Narkomed M will not complete an attempted calibration; however, if the calibration gas is rich or lean but is within certain limits, the Narkomed M will complete the calibration. As a result, when displaying sensor measurements, the Narkomed M displays an oxygen percentage either greater or less than the actual oxygen percentage. Therefore, make sure that the sensor is exposed only to room air during the entire calibration period.

The following figure illustrates the relationship between the calibration mixture and the accuracy of oxygen measurement.

Figure 8-10. Relationship Between Calibration Mixture and Oxygen Measurement Accuracy



Oxygen Alarm Messages

The following list contains all warning, caution, and advisory alarms associated with oxygen monitoring.

INSP O2 LOW (Warning)

The Narkomed M continuously compares the current inspiratory oxygen percentage with the preset low oxygen alarm limit. If the measured oxygen concentration falls below the low alarm limit, the Warning message INSP O2 LOW appears in the Alarm window, and a continuous audible alarm sounds.

INSP O2 HIGH (Advisory)

If the measured inspiratory oxygen concentration exceeds the preset high alarm limit, the Advisory message INSP O2 HIGH appears in the Alarm window, and a single-tone audible alarm sounds.

O2 SENSOR DISC (Advisory)

If the oxygen sensor cord becomes disconnected (or is damaged enough to cause an open circuit), the Advisory message O2 SENSOR DISC appears in the Alarm window, and a single-tone audible alarm sounds.

REPLACE O2 CELL (Advisory)

During oxygen sensor calibration and monitoring, the Narkomed M checks for a difference between the outputs of the two sensor channels. If the difference exceeds a predetermined percentage, the Advisory message REPLACE O2 CELL appears in the Alarm window.

During oxygen sensor calibration, the Narkomed M also checks the sensor's output against a range of acceptable output voltages. There are three possible causes for deviation from within this range.

- *Exhausted sensor.* If the sensor's capacity is exhausted, its output voltage will not meet the required minimum.
- *Incorrect calibration environment.* If the sensor is exposed to an excessive oxygen during calibration, the sensor's output will be above or below the acceptable output range.
- *Improper waiting.* If the proper waiting period is not allowed for a new sensor or for a sensor removed from the sensor housing, the sensor's output may be above or below the acceptable output range.

If a sensor error condition is detected during monitoring, the Advisory message REPLACE O2 CELL appears in the Alarm window and operation continues. Try to recalibrate the sensor; if the message remains, replace the sensor cell.

**CAL O2
SENSOR**
(Advisory)

The Advisory message CAL O2 SENSOR appears in the Alarm window in the following instances:

- the oxygen sensor enters a noncalibrated state
- the Narkomed M is unable to calibrate the oxygen sensor
- more than 18 hours have elapsed since the last calibration

**SERVICE
VENT MON**
(Advisory)

If the Narkomed M detects an internal electronic failure that would prevent proper operation, the Advisory message SERVICE VENT MON appears in the Alarm window. If this happens, contact a qualified technical service representative.

Respiratory Volume Monitoring

Respiratory volume is measured by a respiratory sensor which is attached to the expiratory valve and mounted to the lower absorber pipe. The sensor uses a positive displacement rotating-lobe impeller that generates electronic pulses in response to the patient's expiratory flow. These pulse patterns are converted into meaningful readings for minute volume, tidal volume, and respiratory rate displays.

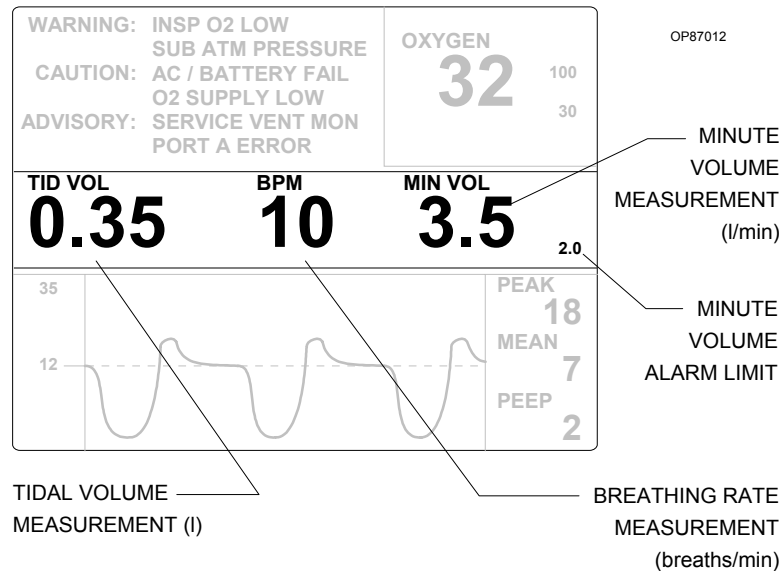
CAUTION: Although the Narkomed M is designed to minimize the effects of ambient radio-frequency interference, the functioning of the respiratory volume monitor may be adversely affected by the operation of electrosurgical equipment or short wave or microwave diathermy equipment in the vicinity.

NOTE: Sudden, irregular expiratory flow may cause erratic tidal volume and respiratory rate displays. To avoid such erroneous measurements, defer reading the display until a full minute has elapsed after the irregular flow has stopped.

**Respiratory
Volume
Display**

Information about the patient's respiratory volume is presented in the Respiratory Volume Monitor window in the middle of the monitor display. From left to right, numerical values are shown in large type for tidal volume, respiratory rate, and minute volume. At the extreme right, in small type, is the minute volume low alarm limit.

Figure 8-11. Respiratory Volume Monitor Window

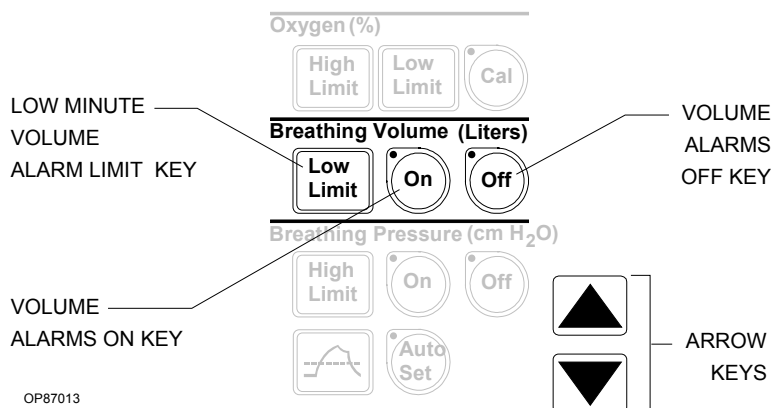


- **Tidal Volume Measurement (TID VOL)**—Displays the volume for each valid breath (at least 50 ml). If the monitor does not detect a valid breath within 30 seconds, the display area goes blank.
- **Breathing Rate Measurement (BPM)**—Shows the number of breaths during the previous minute of respiration. If the BPM display is blank, a full minute of respiration has not occurred.
- **Minute Volume Measurement (MIN VOL)**—Continuously displays the volume of exhaled gas accumulated during the previous minute of respiration. A blank MIN VOL display area indicates that a full one-minute history of exhaled volume is not available.
- **Minute Volume Alarm Limit**—Indicates the volume below which an alarm condition occurs.

Respiratory Volume Monitor Controls

You use the respiratory volume monitor control keys and the arrow keys on the right keypad to set the minute volume low alarm limit and to turn the volume alarms on and off. The respiratory volume monitor control keys are located next to the Respiratory Volume Monitor window.

Figure 8-12. Respiratory Volume Monitor Control Keys



Fixed alarms are provided for low tidal volume (apnea-volume), low minute volume, and reverse flow through the sensor. While the ventilator is on, apnea volume alarms are generated at 15 seconds (Caution) and 30 seconds (Warning) if the respiratory volume monitor does not sense a valid breath. While the ventilator is off, these alarms are generated at 30 seconds (Caution) and 60 seconds (Warning).

The Narkomed M's volume alarms are automatically enabled when the ventilator power switch is turned to the ON position. A disconnected or damaged sensor causes a sensor failure alarm.

Setting the Minute Volume Low Alarm Limit



Follow these steps to adjust the minute volume low alarm limit:

1. Press the Breathing Volume Low Limit key.
A box is drawn around the minute volume low alarm limit.
2. Press the up arrow or down arrow key to increase or decrease the highlighted alarm limit.
3. To save the new value, stop pressing arrow keys until the highlighting box disappears (5 seconds), or press a different alarm Limit key.

The new value is saved as the alarm limit.

Turning Respiratory Volume Alarms Off

To turn off the respiratory volume alarms, press the Breathing Volume Off key.



The alarms stop sounding and their messages are erased from the display. In addition, the LED next to the Breathing Volume Off key lights to indicate the Off condition.

Turning Respiratory Volume Alarms On

To turn on the respiratory volume alarms, press the Breathing Volume On key.



The LED next to the Breathing Volume On key lights to indicate that the volume alarms are enabled.

NOTE: You cannot turn on volume alarms during power-up. They are automatically forced off to prevent nuisance alarms during patient setup.

Respiratory Volume Alarm Messages

The following list contains all warning, caution, and advisory alarms associated with respiratory volume monitoring.

APNEA- VOLUME (Warning/ Caution)

The Narkomed M continuously monitors the expiratory flow in the patient breathing system. By processing the expiratory flow pattern, the monitor can determine whether a “valid” breath has occurred. A “valid” breath has a tidal volume of 50 ml or greater.

When the ventilator is on:

- If 15 seconds pass and a valid breath is not detected, the Caution message APNEA-VOLUME appears in the Alarm window, and an intermittent audible alarm sounds.
- If an additional 15 seconds pass (30 seconds total) and a valid breath is not detected, the Caution message APNEA-VOLUME is upgraded to a Warning in the Alarm window, and a continuously repeating audible alarm sounds.

When the ventilator is off:

- The Caution condition does not occur until 30 seconds have elapsed.
- The Warning condition does not occur until 60 seconds have elapsed.

During apneic conditions, the respiratory volume measurements disappear after 30 seconds. When a valid breath is detected, alarm annunciation ceases and a tidal volume measurement appears in the display window. However, a full minute of respiratory activity must be registered before the minute volume and respiratory rate appear.

NOTE: You can disable volume-related alarms by pressing the Breathing Volume Off key.

MINUTE VOLUME LOW (Caution)	Whenever the Narkomed M measures a minute volume less than the low minute volume alarm limit, the Caution message MINUTE VOLUME LOW appears in the Alarm window, and an intermittent audible alarm sounds.
REVERSE FLOW (Advisory)	<p>If a reverse flow in excess of 20 ml is detected, the Advisory message REVERSE FLOW appears in the Alarm window, and a single-tone audible alarm sounds.</p> <p>A forward flow greater than 20 ml clears the alarm condition. The REVERSE FLOW alarm message remains on the screen for 5 seconds after the resumption of forward flow to allow for recognition of an intermittent reverse flow condition.</p>
VOL SENSOR DISC (Advisory)	If the respiratory volume sensor cord is not properly connected to the VOLUME SENSOR interface on the anesthesia machine (or if the cord is damaged enough to cause an open circuit), the Advisory messages VOL SENSOR DISC and VOL ALARMS OFF appear in the Alarm window.
VOL ALARMS STBY (Advisory)	When the volume alarms have been set to Standby, the Advisory message VOL ALARMS STBY appears in the Alarm window.
SERVICE VENT MON (Advisory)	If the Narkomed M detects an internal electronic failure that would prevent proper operation, the Advisory message SERVICE VENT MON appears in the Alarm window. If this happens, contact a qualified technical service representative.

Breathing Pressure Monitoring

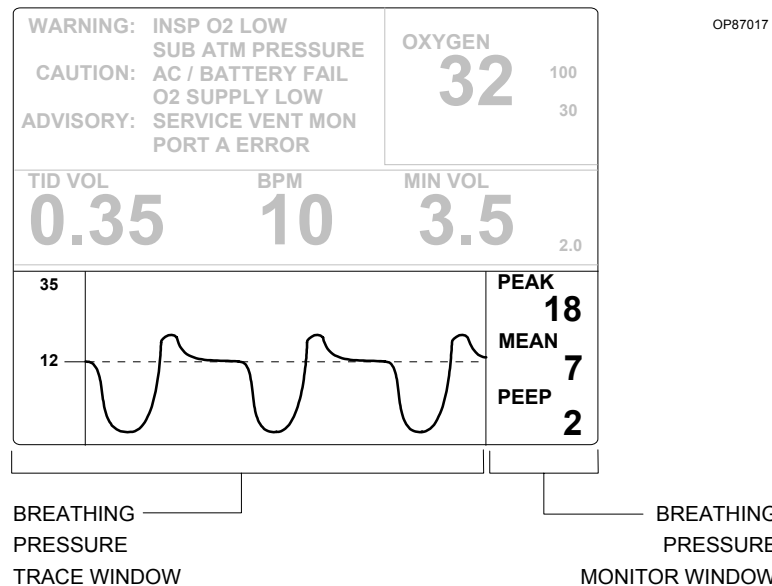
Breathing pressure is measured with a solid-state pressure transducer that can sense pressure at the inspiratory valve.

Draeger Medical, Inc. disagrees with the idea of relying on pressure monitoring to detect a blocked breathing circuit. Carbon dioxide monitoring and respiratory flow monitoring provide superior detection of blocked breathing paths when compared to pressure monitoring, which detects such conditions only in some instances. Draeger Medical, Inc. pressure monitors are therefore not promoted for detection of blocked breathing paths.

Breathing Pressure Monitoring Displays

Information about the patient's breathing pressure is presented in two windows at the bottom of the monitor display.

Figure 8-13. Breathing Pressure Monitor and Trace Window

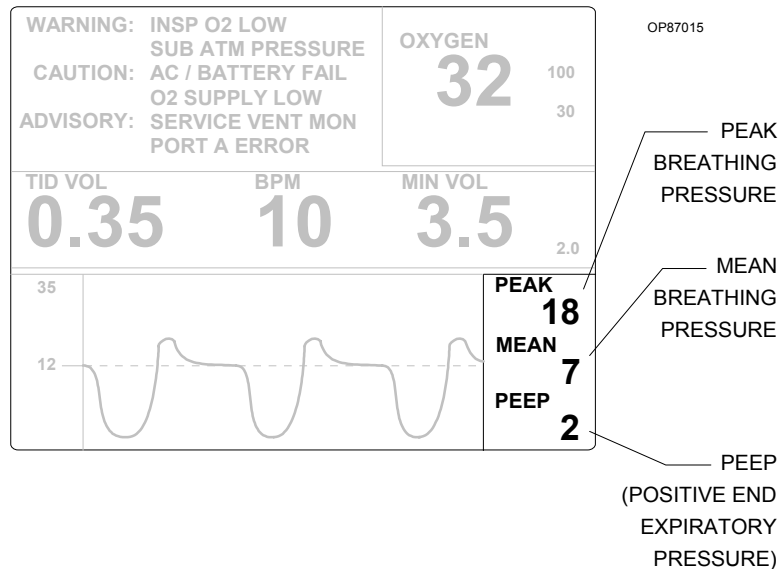


- **Breathing Pressure Trace Window**—This large window on the left displays a breathing pressure trace, or waveform. To the left of the waveform, in small type, are the pressure high and threshold pressure alarm limits.
- **Breathing Pressure Monitor Window**—This small window on the right contains numerical breathing pressure measurements.

Breathing Pressure Monitor Window

The Breathing Pressure Monitor window contains breathing pressure measurements expressed in units of cmH_2O .

Figure 8-14. Breathing Pressure Monitor Window



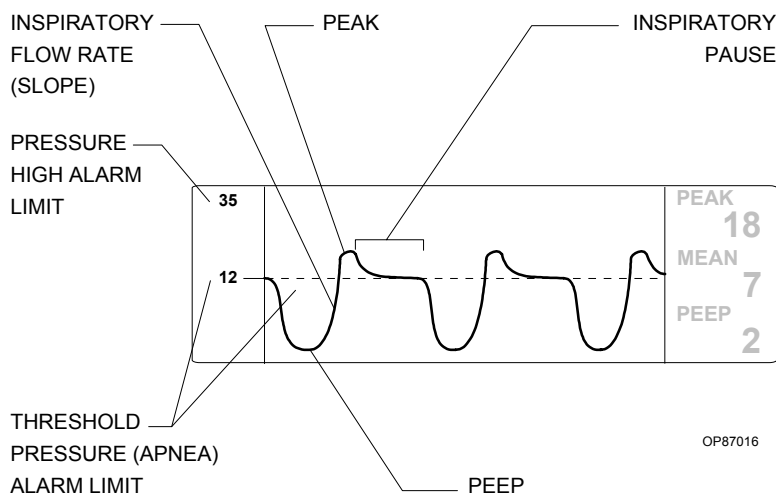
- **PEAK Breathing Pressure**—The highest instantaneous pressure value for each breath
- **MEAN Breathing Pressure**—The average of all the instantaneous pressure values recorded during each breath
- **PEEP (Positive End Expiratory Pressure)**—The breathing pressure at the end of exhalation

During apneic conditions, the pressure monitor displays numeric information as long as it detects a peak pressure at least $10 \text{ cmH}_2\text{O}$ greater than PEEP pressure. When this pressure difference drops below $10 \text{ cmH}_2\text{O}$, the numeric information remains 1 minute longer and then disappears.

Breathing Pressure Trace Window

The Breathing Pressure Trace window displays the breathing pressure waveform, and the pressure high and threshold pressure alarm limits. Pressure measurements are displayed in units of cmH_2O and are automatically scaled from 0-20, 0-50, or 0-100 cmH_2O . If the scale changes, the positions of the waveform and alarm limits also change relative to the new scale. The window below has a scale of 0–20 cmH_2O .

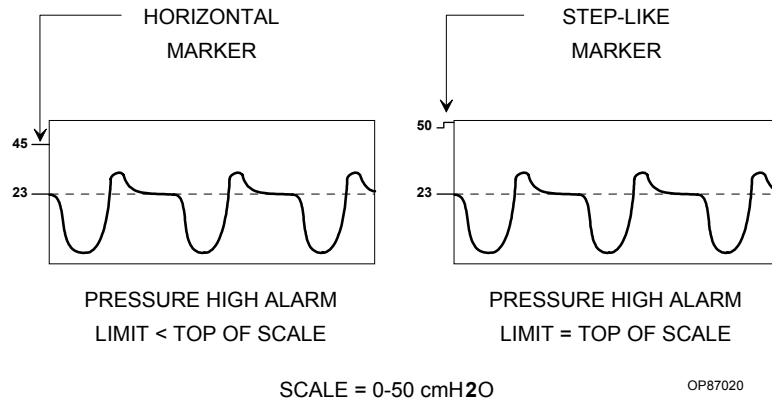
Figure 8-15. Breathing Pressure Trace Window



- The peak of the waveform corresponds to the peak pressure.
- The slope of the trace as it rises toward the peak pressure is correlated with the inspiratory flow rate; the steeper the slope, the higher the flow rate.
- The amount of pressure that the baseline is raised from zero corresponds to the patient's positive end expiratory pressure (PEEP).
- The length of the plateau from peak pressure to the decrease in pressure corresponding to expiration is equivalent to the length of the inspiratory pause (if present).
- The horizontal dotted line on the waveform and the adjacent marker on the Y-axis both represent the threshold pressure (apnea) alarm limit. The horizontal dotted line is always displayed, but the marker on the Y-axis appears only when the threshold pressure alarm limit is less than or equal to the top of the scale set by the system. There is a marker in the illustration above, because the threshold pressure alarm limit (12 cmH₂O) is less than the top of the scale (20 cmH₂O).
- The pressure high alarm limit is denoted by a marker on the Y-axis only when it is less than or equal to the top of the scale set by the system. In Figure 8-15, the pressure high alarm limit (35 cmH₂O) is greater than the top of the scale (20 cmH₂O). When a high alarm limit marker is displayed, its appearance depends on whether the pressure high alarm limit is less than or equal

to the top of the scale. The following examples illustrate the difference in appearance. (Note that a threshold pressure alarm limit marker is also displayed in these examples.)

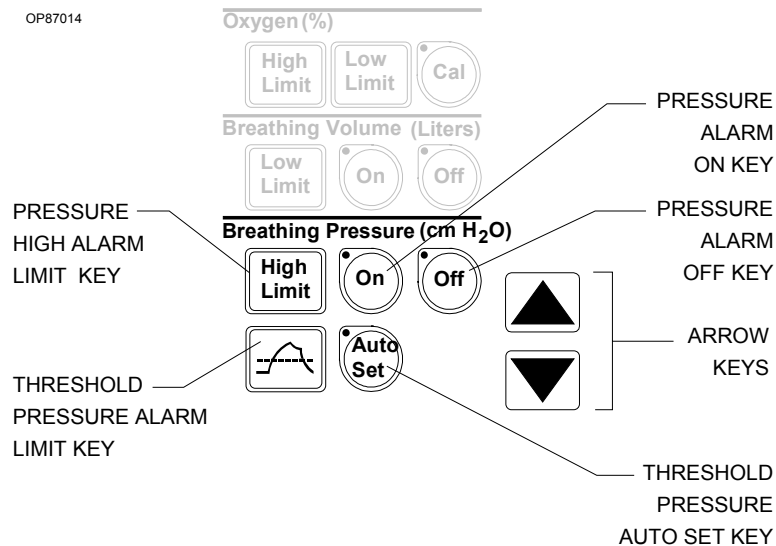
Figure 8-16. Trace Markers



Breathing Pressure Monitor Controls

You use the breathing pressure monitor control keys to set breathing pressure alarm limits, turn the apnea (threshold pressure) alarm off or on, and automatically set the threshold pressure. The breathing pressure monitor control keys are located next to the Breathing Pressure Monitor window.

Figure 8-17. Breathing Pressure Monitor Control Keys



Setting the Pressure High Alarm Limit



The pressure high alarm limit is automatically set to 50 cmH₂O at power-up. You can change this limit to any value from 30–120 cmH₂O, as long as it is greater than the threshold pressure alarm limit.

To adjust the pressure high alarm limit, follow these steps:

1. Press the Breathing Pressure High Limit key.
A box is drawn around the pressure high alarm limit.
2. Press the up arrow or down arrow key to increase or decrease the pressure high alarm limit.
3. To save the new value, stop pressing arrow keys until the highlighting box disappears (5 seconds), or press a different Alarm Limit key.

The new value is saved and displayed as the pressure high alarm limit. If the alarm limit is on or below the upper limit of the scale, a marker appears next to the alarm limit.

Setting the Threshold Pressure Alarm Limit

The threshold pressure alarm limit defines the level below which an apneic alarm condition exists. When the patient's breathing pressure falls below the threshold limit, a message appears in the Alarm window and an audible alarm sounds.

The threshold pressure alarm limit is automatically set to 12 cmH₂O at power-up. The setting can be changed to any value from 5–30 cmH₂O, as long as it is less than the pressure high alarm limit. You can change the alarm limit manually to a value you select or have the system set it automatically to an optimum value based on the current peak pressure.

WARNING: The threshold pressure alarm limit should be as close as possible to the sensed peak pressure without exceeding it. For details, see “Threshold Limit Guidelines” and “Sample Threshold Limit Settings” in this section.

Manually Setting the Threshold Limit



To set the threshold pressure alarm limit manually, follow these steps. Remember that the value must be within the range of 5–30 cmH₂O and less than the pressure high alarm limit.

1. Press the Breathing Pressure Threshold key.
A box is drawn around the threshold pressure alarm limit.
2. Press the up arrow or down arrow key to increase or decrease the threshold pressure alarm limit.

3. To save the new value, stop pressing arrow keys until the highlighting box disappears (5 seconds), or press a different Alarm Limit key.

The new value is saved and displayed as the threshold pressure alarm limit. If the alarm limit is on or below the upper limit of the scale, a marker appears next to the alarm limit, and a dotted line extends from the alarm limit horizontally across the scale.

Automatically Setting the Threshold Limit



You can have the monitoring system automatically set the threshold pressure alarm limit to an optimum value based on the current peak pressure.

To automatically set the threshold pressure alarm limit, press and then release the Breathing Pressure Auto Set key.

The LED next to the Breathing Pressure Auto Set key lights briefly when you press it.

The threshold pressure limit is automatically set 4 cmH₂O below the current peak pressure measurement, to a minimum of 5 cmH₂O and a maximum of 30 cmH₂O.

If the alarm limit is on or below the upper limit of the scale, a marker appears next to the alarm limit, and a dotted line extends from the alarm limit horizontally across the scale.

Threshold Limit Guidelines

If a breathing system leak or partial disconnection occurs when the threshold pressure alarm limit is set significantly lower than the peak pressure, continued positive pressure ventilation can produce a pressure fluctuation great enough to exceed the threshold (and thereby satisfy the alarm), yet not great enough to provide adequate ventilation.

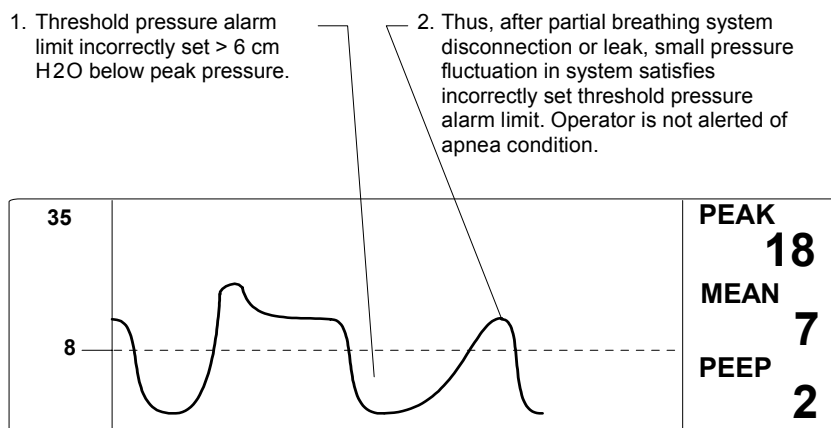
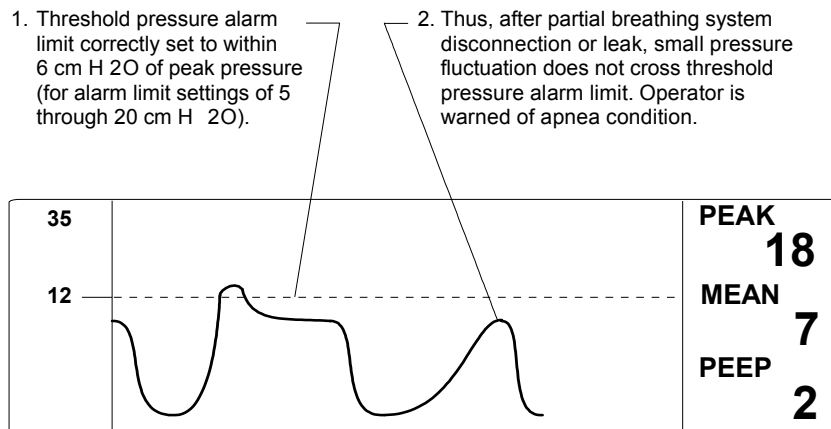
To address the problem, the Advisory message **THRESHOLD LOW** appears in the Alarm window when either of the following conditions occurs:

- The sensed peak pressure exceeds the set threshold by more than 6 cmH₂O at threshold pressure alarm limit settings of 5–20 cmH₂O.
- The sensed peak pressure exceeds the set threshold by more than 8 cmH₂O at threshold pressure alarm limit settings of 21–29 cmH₂O.

NOTE: The threshold setting may be affected when the ventilator is turned on or off. If you turn the ventilator off while the threshold is set to a value greater than 15 cmH₂O, the setting is changed to 15 cmH₂O. (If the threshold is set lower than 15 cmH₂O when the ventilator is turned off, the threshold retains its setting.) When the ventilator is turned back on, the threshold is restored to its previous set value.

Sample Threshold Limit Settings The figure below illustrates the effects of correct and incorrect settings of the threshold pressure alarm limit.

Figure 8-18. Sample Threshold Limit Settings



Turning the Apnea Pressure Alarm Off

You can turn the apnea pressure alarm off only when the ventilator is off. When the ventilator is on, the alarm is automatically forced on to ensure notification of problem conditions.



To turn off the apnea pressure alarm, press the Breathing Pressure Off key.

Audio annunciation of the alarm is disabled and pressure alarm messages are erased from the display. The LED next to the Breathing Pressure Off key lights to indicate that the apnea pressure alarm is disabled.

Turning the Apnea Pressure Alarm On

To turn on the apnea pressure alarm, press the Breathing Pressure On key.



The LED next to the Breathing Pressure On key lights to indicate that the apnea pressure alarm is enabled.

NOTE: You cannot turn on the apnea pressure alarm during power-up. It is automatically forced off to prevent nuisance alarms during patient setup.

Breathing Pressure Alarm Messages

The following list contains all warning, caution and advisory alarms associated with breathing pressure monitoring.

APNEA-PRESSURE (Warning/ Caution)

When the ventilator is on:

- If the measured breathing pressure remains below the threshold pressure alarm limit for more than 15 seconds, the Caution message APNEA-PRESSURE appears in the Alarm window and an intermittent audible alarm sounds.
- If the breathing pressure remains below the threshold pressure for an additional 15 seconds (30 seconds total), the Caution message APNEA-PRESSURE is upgraded to a Warning in the Alarm window, and a continuously repeating audible alarm sounds. During the Warning condition, numeric data remains on the display as long as the monitor detects a peak pressure at least 10 cmH₂O greater than PEEP pressure. When this pressure difference drops and remains below 10 cmH₂O for more than 60 seconds, the numeric data is cleared.

When the ventilator is off:

- The Caution condition does not occur until 30 seconds have elapsed.
- The Warning condition does not occur until 60 seconds have elapsed.

**VENT
PRESSURE
HI (Warning)**

If the measured breathing pressure exceeds the high pressure limit, the Warning message VENT PRESSURE HI appears in the Alarm window and a continuously repeating audible alarm sounds.

This alarm condition is cleared when the measured breathing pressure drops below the high pressure alarm limit. However, the alarm message is extended for 5 seconds to allow for a momentary high pressure condition.

**SUB ATM
PRESSURE
(Warning)**

If the measured breathing pressure falls below -10 cmH₂O, the Warning message SUB ATM PRESSURE appears in the Alarm window and a continuously repeating audible alarm sounds.

This alarm condition is cleared when the sensed pressure rises above -10 cmH₂O. However, the alarm message is extended for 5 seconds to allow the recognition of a momentary subatmospheric pressure condition.

**CONTINUOU
S PRES
(Warning)**

If the measured breathing pressure remains above the threshold pressure alarm limit for more than 15 seconds, the breathing pressure display area is cleared, the Warning message CONTINUOUS PRES appears in the Alarm window, and an intermittent audible alarm sounds.

When the measured breathing pressure drops below the threshold pressure alarm limit, alarm annunciation ceases.

**PEEP > 25
(Caution)**

Any time that the monitor measures a PEEP of 26 cmH₂O or greater, the Caution message PEEP > 25 appears in the Alarm window and an intermittent audible alarm sounds.

Alarm annunciation ceases when the measured PEEP drops below 26 cmH₂O. Also, an APNEA or CONTINUING PRESSURE alarm condition will clear this alarm condition.

**THRESHOLD
LOW
(Advisory)**

The Advisory message THRESHOLD LOW appears in the Alarm window any time the sensed peak pressure exceeds the threshold pressure alarm limit by more than 6 cmH₂O at threshold pressure alarm limit settings of 5–20 cmH₂O, or by more than 8 cmH₂O at threshold pressure alarm limit settings of 21–29 cmH₂O. Setting the threshold pressure alarm limit at 30 cmH₂O disables the THRESHOLD LOW advisory.

8	Using the Monitoring System
PEEP > 4 (Advisory)	<p>Any time the monitor measures a PEEP of 5 cmH₂O or greater, the Advisory message PEEP > 4 appears in the Alarm window.</p> <p>When the measured PEEP drops below 5 cmH₂O, the Advisory message is cleared from the display.</p>
APNEA-P ALM STBY (Advisory)	<p>Any time that the apnea pressure alarm (threshold pressure alarm limit) has been set to Standby, the Advisory message APNEA-P ALM STBY appears in the Alarm window.</p>
SERVICE VENT MON (Advisory)	<p>If the Narkomed M detects an internal electronic failure that would prevent proper operation, the Advisory message SERVICE VENT MON appears in the Alarm window. If this happens, contact a qualified technical service representative.</p>

Routine Maintenance and Cleaning

Overview

This section outlines procedures for maintaining and cleaning the Narkomed M.

Routine Maintenance

Routine maintenance must be performed regularly to ensure safe and effective operation. Regularly check the condition of the absorbent and the overall condition of the machine, power cord, hoses, and breathing bag.

Replacing the Absorbent

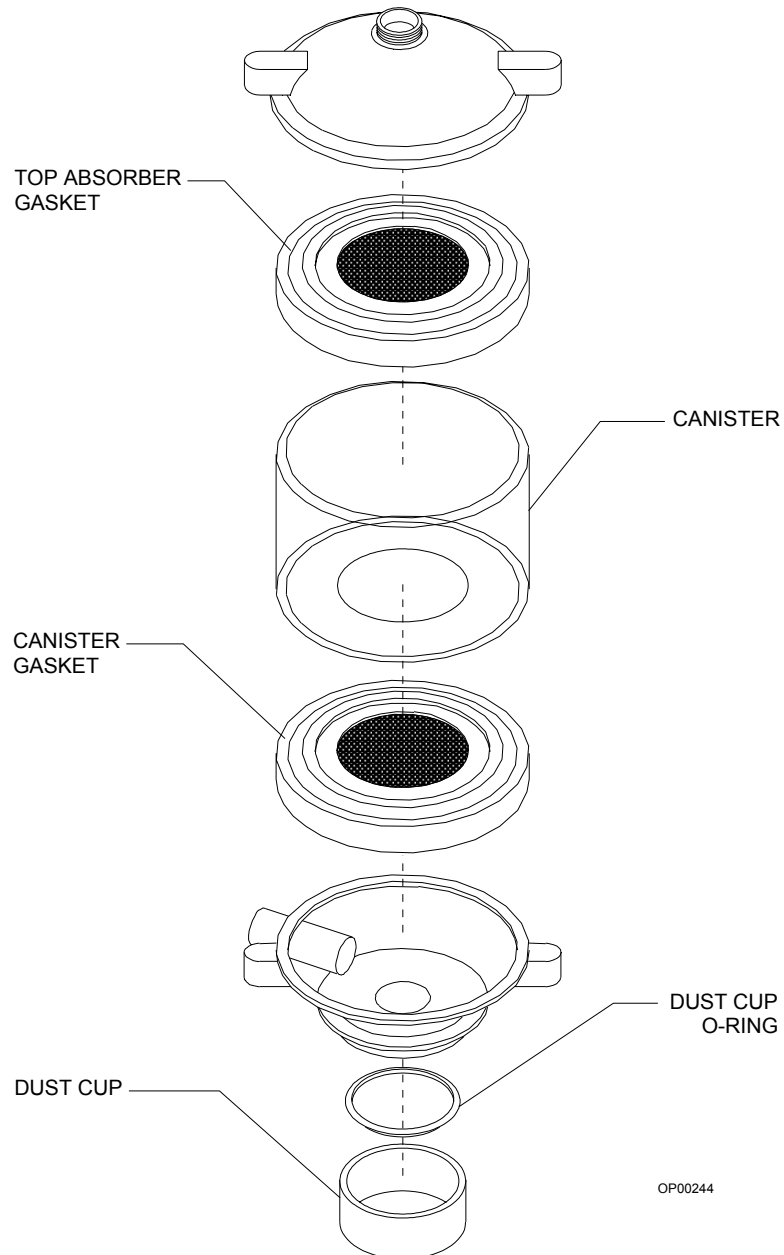
When the carbon dioxide absorbent in the absorber system is exhausted, it must be replaced. Refer to the manufacturer's instructions for the signs to expect when the absorbent is exhausted.

If the machine has been out of use or in storage, replace the absorbent before using the machine. Draeger Medical, Inc. recommends establishing a routine schedule with a sufficient safety margin for replacing absorbent.

When using loose absorbent, do not fill above the maximum fill level line located about a quarter-inch from the top of the canister. The clearance and the ratio of canister diameter to screen opening minimize the potential for channeling. In channeling, gas flows through the canister along the path of least resistance. The gas depletes the efficiency of the absorbent along this route, bypassing absorbent in the other areas of the absorber.

WARNING: Absorbent is caustic and is a strong irritant to the eyes, skin, and respiratory tract. When replacing the absorbent, take care not to spill its caustic contents.

Figure 9-1. Disassembled Canister Assembly



To replace the absorbent:

1. Pull the canister release lever down.
2. Remove the canister from the absorber system.
3. Empty the contents of the canister into an appropriate refuse container.
4. Check the canister to make sure it is not chipped or cracked.
5. Taking care not to chip or crack the canister, add new absorbent.
 - When using absorbent prepacks, remove all packaging materials (some have clear plastic wrappers) and place a prepack into the canister.
 - When using loose absorbent, fill the canister to the fill line. Do not overfill.
6. Center the canister on the gasket of the bottom dome.
7. Raise the bottom dome, remove and empty the dust cup if loose absorbent is present, and replace the dust cup.
8. Pull the canister release lever up to close the absorber system.
9. Perform the absorber portion of the daily checkout procedure provided in the “Daily Checkout” section to verify proper reassembly.

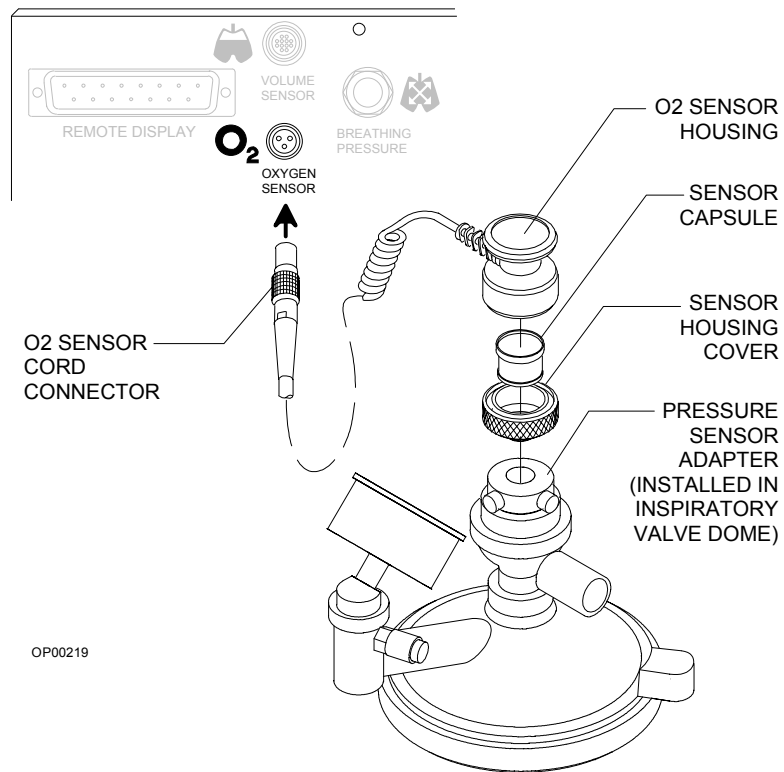
**Replacing
the Oxygen
Sensor
Capsule**

Replace the oxygen sensor capsule when its sensor is depleted, because a depleted sensor cannot correctly analyze oxygen concentrations.

1. Turn the SYSTEM POWER switch to STANDBY.
2. Remove the oxygen sensor housing from the inspiratory valve dome. (It is a press fit.)
3. Unscrew the cover from the sensor housing and remove the sensor capsule.
4. Install the replacement sensor in the housing. Verify that the copper rings on the capsule mate with the electrical contacts in the sensor housing.
5. Wait 15 minutes to let the sensor capsule stabilize to ambient air.

If you do not wait, calibration (the next step) will not be successful.
6. Restore power to the machine and calibrate the oxygen sensor. This procedure is provided in “Using the Monitoring System.”

Figure 9-2. Disassembled Oxygen Sensor

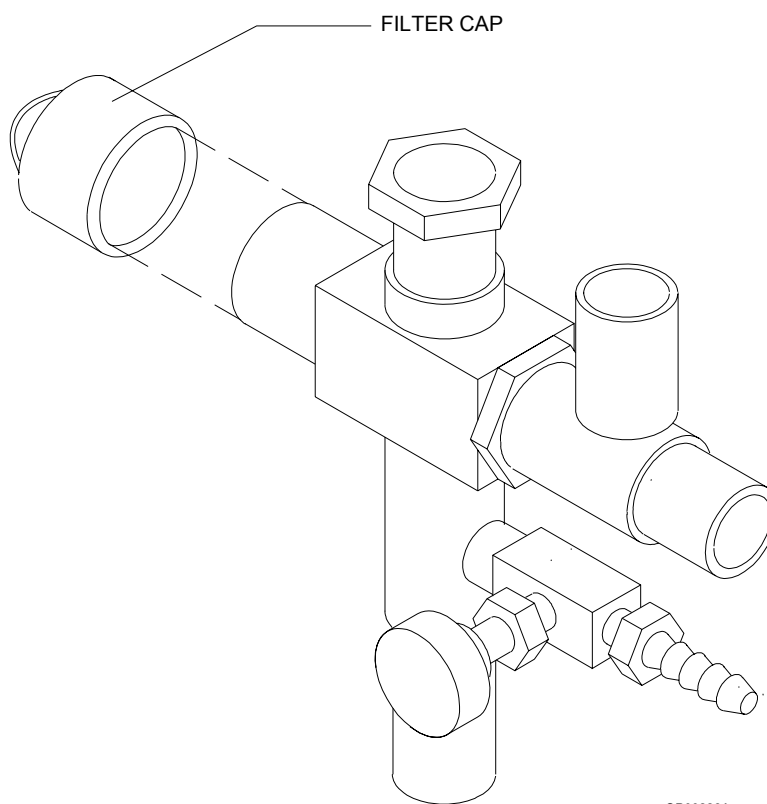


**Scavenger
Interface
Maintenance**

Draeger Medical, Inc. recommends routine maintenance for the scavenger interface and attachments. Follow this procedure every 6 months.

1. Wipe the scavenger body with a soft lint-free cloth moistened with mild detergent and water.
2. Inspect all scavenger hoses for signs of wear and deterioration. Replace any worn hoses.
3. Remove the filter valve cap by pulling it off the scavenger.
4. Inspect the filter in the cap.
5. If necessary, remove the filter from the cap for cleaning. Brush any accumulated lint or dust off the filter. The filter can be further cleaned with a low flow of clean air or oxygen.

Figure 9-3. Removing the Scavenger Filter Valve Cap



OP00228A

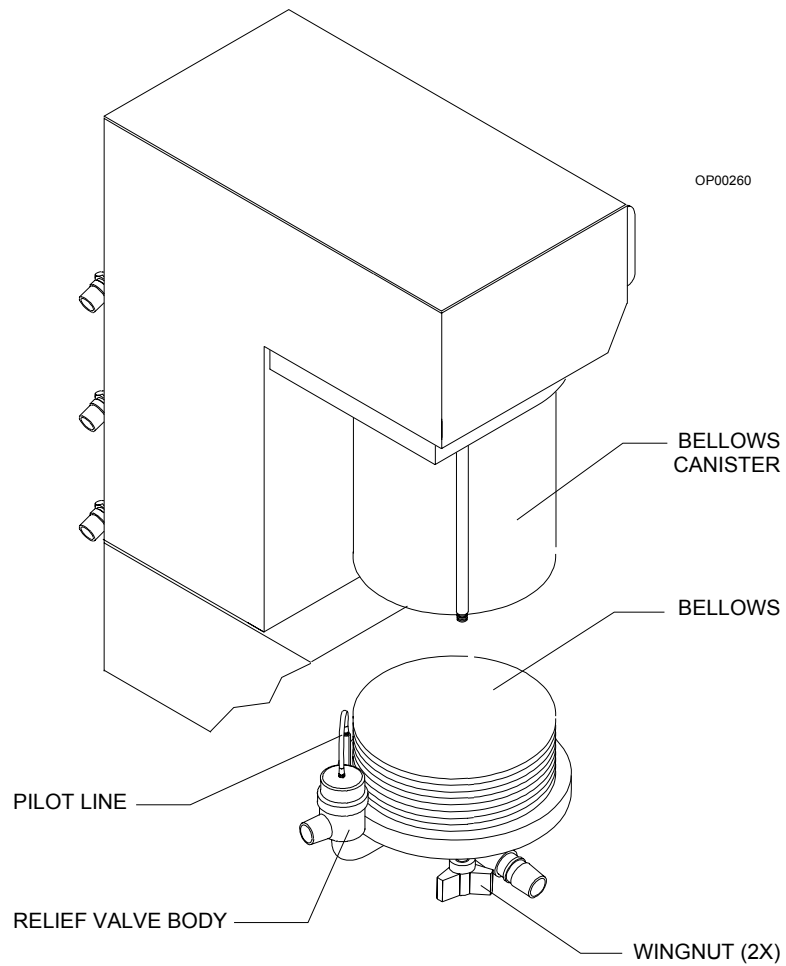
6. Place the filter back into the cap, making sure that it lays flat against the inside of the cap.
7. Reinstall the cap on the scavenger body, making sure that the filter is properly seated.
8. Perform the scavenger interface portion of the daily checkout procedure provided in this manual.

NOTE: The scavenger interface generally does not need disinfection. However, if your facility requires a disinfection process for the scavenger interface and hoses, remove the scavenger and all 19 mm hoses. Refer back to the cleaning instructions under “Scavenger Maintenance” for disassembly instructions.

Removing Parts for Cleaning and Disinfection

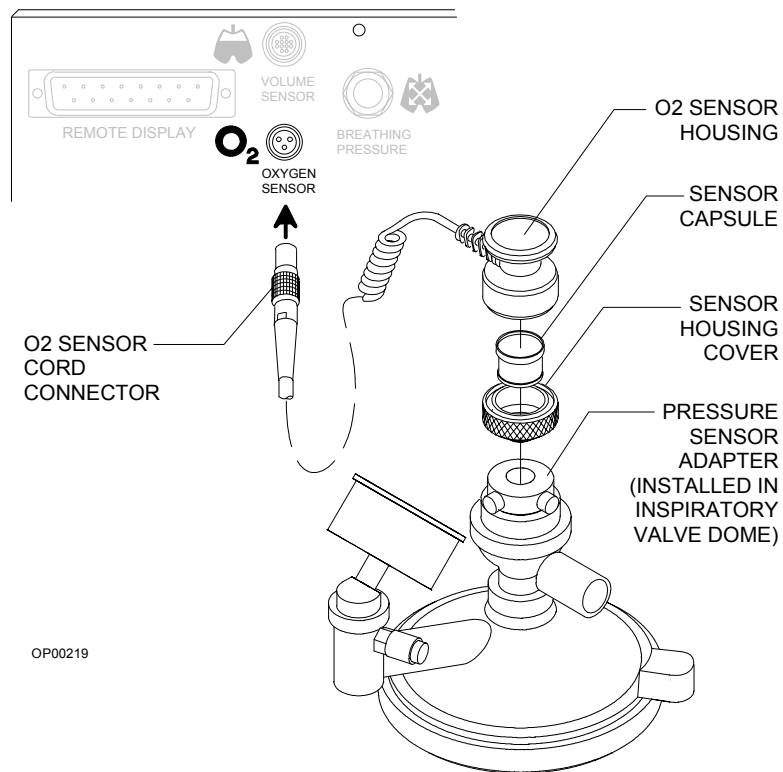
1. Turn the SYSTEM POWER switch to STANDBY.
2. Disconnect the breathing circuit hoses from the inspiratory and expiratory valves. Remove the Y-piece, mask, and mask elbow from the hoses.
3. Disconnect the 19 mm scavenger hoses from the APL valve and the ventilator relief valve.
4. While supporting the bottom of the assembly, loosen the two wing nuts located below the ventilator bellows canister until the assembly releases from the canister.

Figure 9-4. Disassembling the Ventilator Bellows Assembly



5. Disconnect the oxygen sensor connector from the system interface panel.
6. Separate the oxygen sensor housing from the breathing pressure sensor adapter. (It is a press fit.)

Figure 9-5. Disassembled Oxygen Sensor

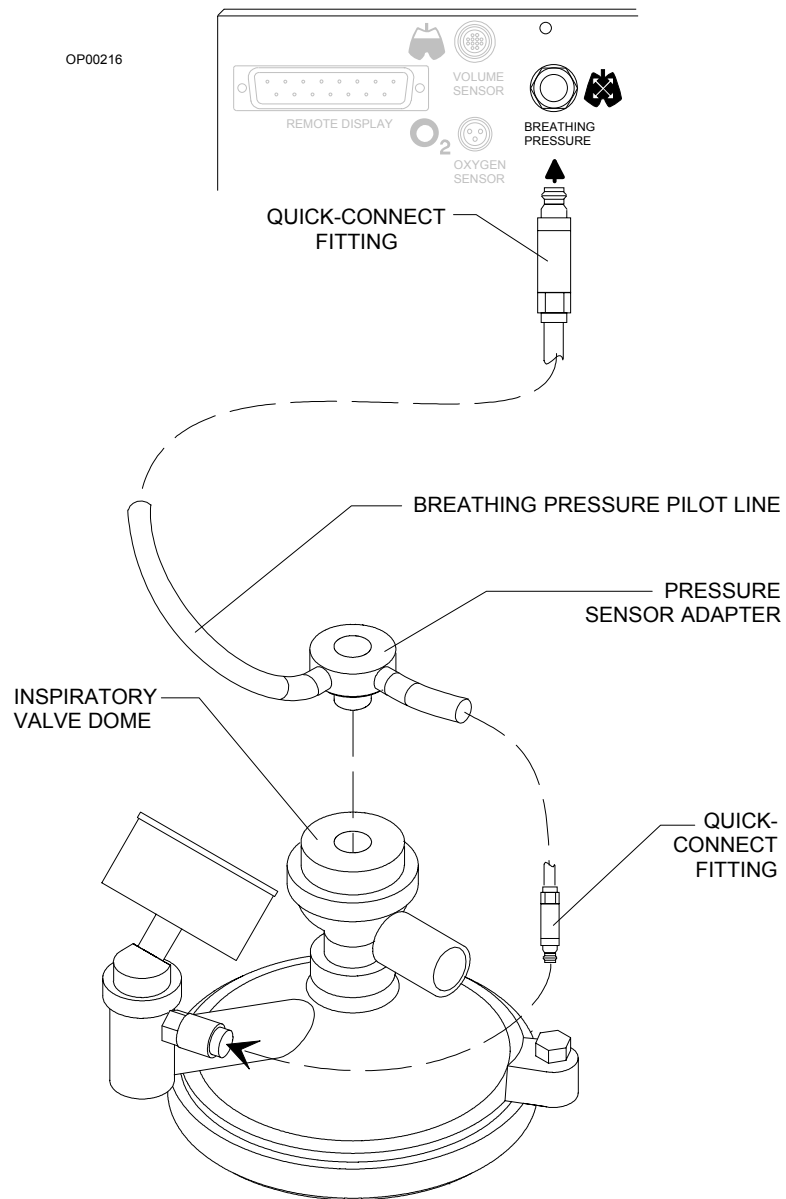


Routine Maintenance and Cleaning

9

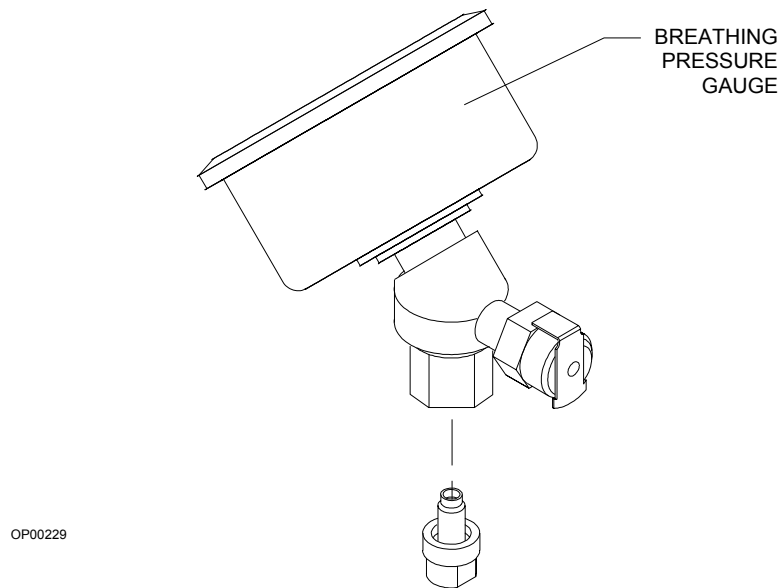
7. Disconnect the breathing pressure sensor quick-connect fitting from the system interface panel.
8. Disconnect the quick-connect fitting from the pressure gauge.
9. Separate the pressure sensor adapter from the inspiratory valve dome. (It is a press fit.)

Figure 9-6. Disassembled Breathing Pressure Sensor



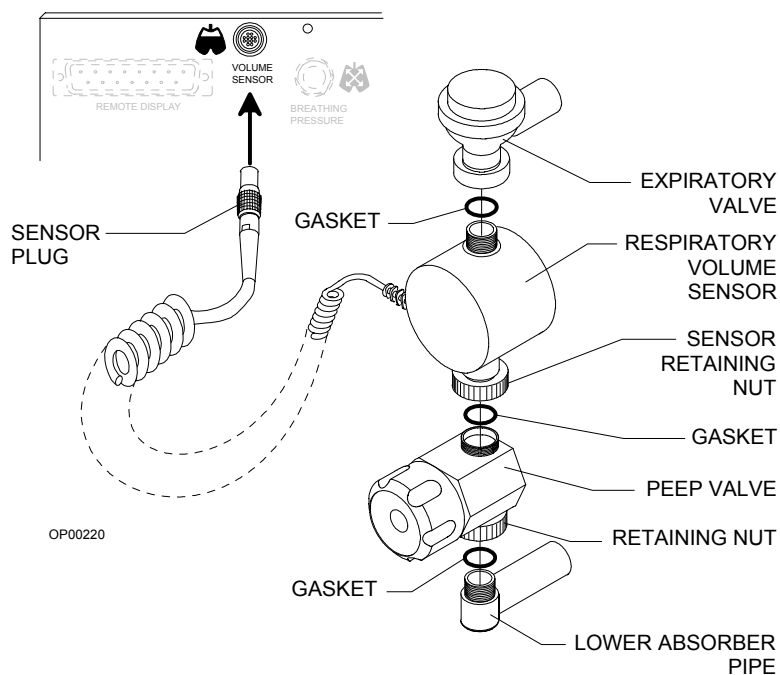
10. Turn the nut that connects the pressure gauge to the gauge mount to the absorber assembly counterclockwise.
11. Lift the pressure gauge assembly off the gauge mount. Be sure to keep the o-ring with the pressure gauge assembly.

Figure 9-7. Disassembled Breathing Pressure Gauge



12. Remove the expiratory valve, PEEP valve, and respiratory volume sensor. Hold the assembly and turn the sensor retaining nut counterclockwise until the assembly can be removed from the lower absorber pipe. Take care not to lose the gasket.

Figure 9-8. Disassembled Expiratory Valve, PEEP Valve, Respiratory Volume Sensor

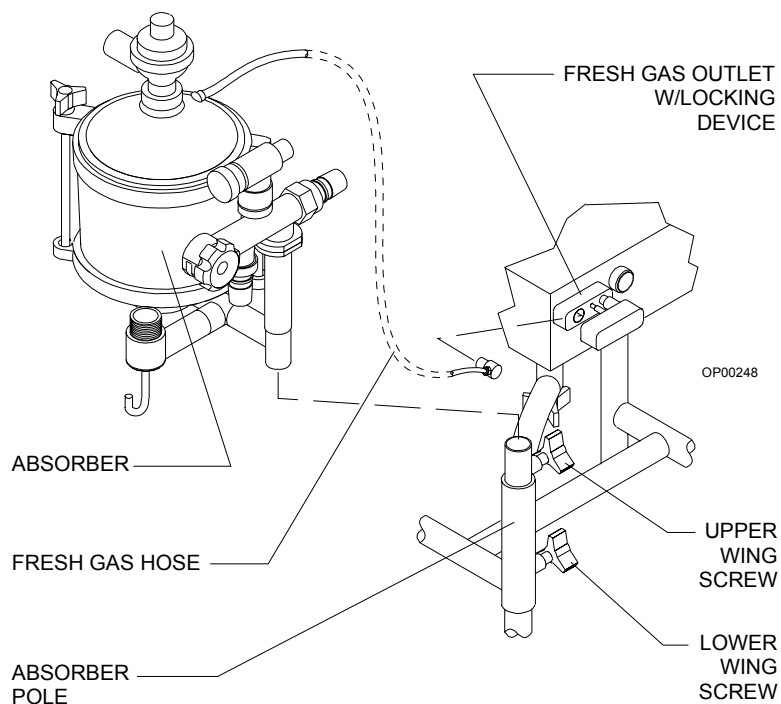


13. Remove the absorbent from the absorber canister. Refer back to “Routine Maintenance - Replacing the Absorbent” in this chapter for instructions.

WARNING: Absorbent is caustic and a strong irritant to the eyes, skin, and respiratory tract. When removing the absorbent, take care not to spill its caustic contents.

14. Disconnect the fresh gas hose from the fresh gas outlet.
15. Loosen the upper wing screw to release the absorber from the absorber pole.
16. Lift the absorber off the pole.

Figure 9-9. Absorber Disassembled from Absorber Pole



NOTE: The scavenger interface generally does not need to be disinfected. However, if the user facility mandates disinfection for the scavenger interface and hoses, remove the scavenger, hoses, and bag (if used) as described in the following steps.

17. Remove the 19 mm scavenger hoses from the scavenger interface.
18. If a passive scavenger system is used, disconnect the exhaust system hose from the scavenger. If a suction scavenger system was used, disconnect the suction hose and remove the bag from the scavenger.
19. Slide the scavenger interface up the slide mount until it is free of the frame.

Disassembling Parts for Cleaning and Disinfection

The following parts must be further disassembled for thorough cleaning and disinfection:

- oxygen sensor assembly
- ventilator bellows assembly and ventilator bellows bottom assembly
- expiratory valve, PEEP valve, respiratory volume sensor assembly
- inspiratory/expiratory valves

Disassembling the Ventilator Bellows Assembly

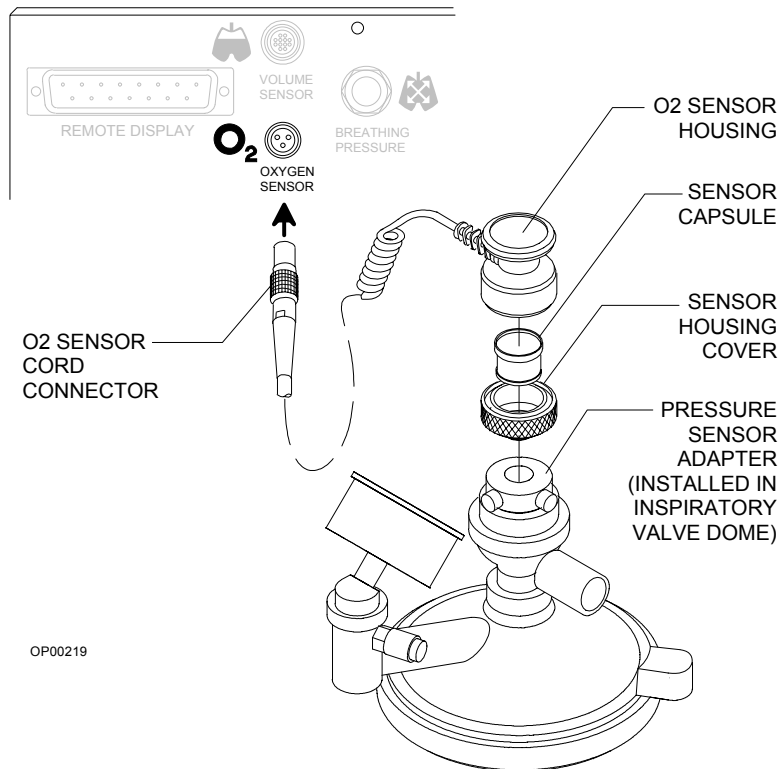
Remove the bellows from the ventilator bottom assembly by unscrewing it in a counterclockwise direction until it is released.

CAUTION: Take special care not to change the position of the adjustment lock ring on the ventilator relief valve dome. Do not attempt to loosen the knurled relief valve ring nut by twisting the pilot line hose barb.

Disassembling the Oxygen Sensor Assembly

Unscrew the cover from the sensor housing and remove the sensor capsule. Take care not to drop the sensor housed inside. The sensor is not connected to the housing.

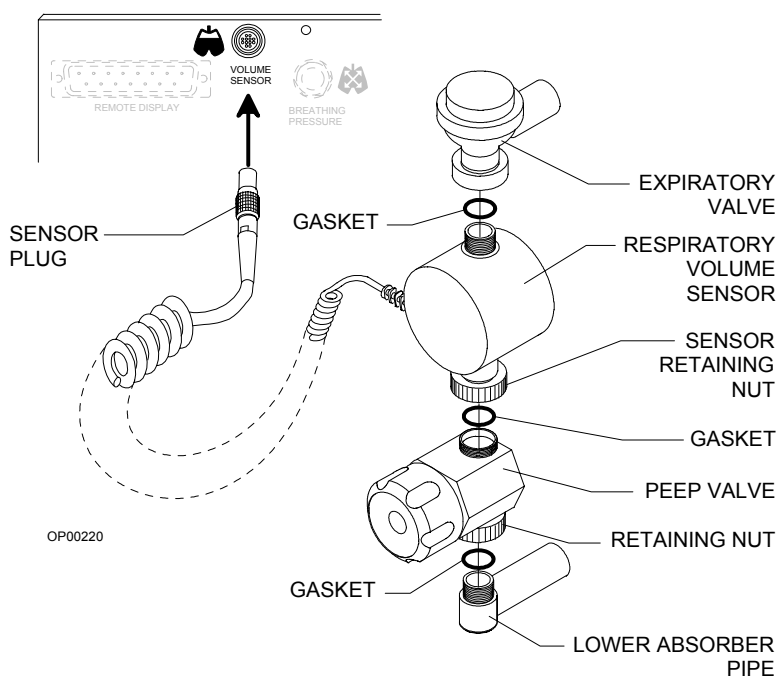
Figure 9-10. Disassembled Oxygen Sensor Assembly



Disassembling the Expiratory Valve, PEEP Valve, and Respiratory Volume Sensor

1. Turn the expiratory valve counterclockwise until it can be removed from the assembly. Take care not to lose the gasket that fits between the expiratory valve and the PEEP valve.
2. Turn the retaining nut of the PEEP valve counterclockwise until the PEEP valve can be removed from the assembly. Take care not to lose the gasket that fits between the PEEP valve and the respiratory volume sensor.

Figure 9-11. Disassembled Expiratory Valve, PEEP Valve, and Respiratory Volume Sensor



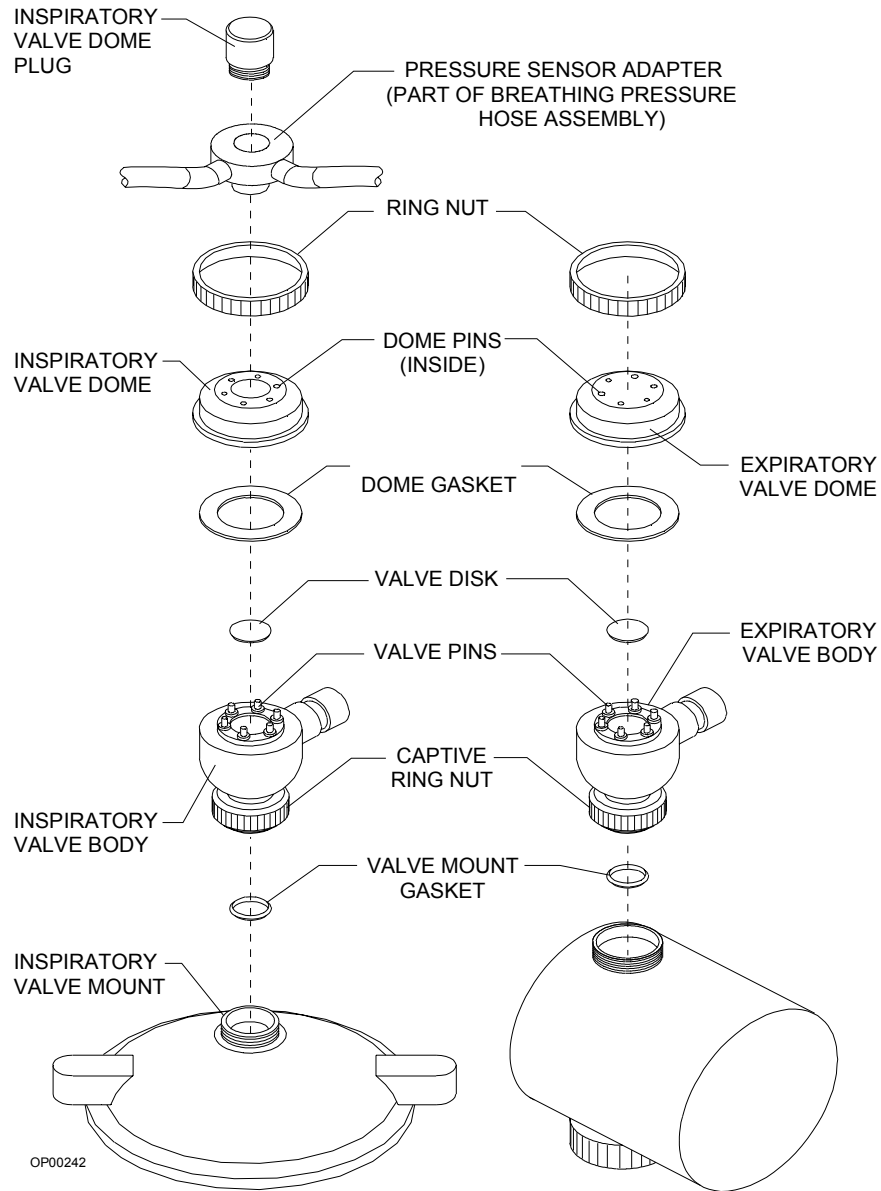
Routine Maintenance and Cleaning

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Disassembling the Inspiratory and Expiratory Valves

1. Remove the inspiratory valve from the absorber dome by turning it counterclockwise. (The expiratory valve should already have been removed from the expiratory valve, PEEP valve, and respiratory volume sensor assembly.)
2. Unscrew and remove the ring nut around the valve dome on both valve assemblies.
3. Separate the plastic dome, dome gasket, and valve disk from each valve body.

Figure 9-12. Disassembled Inspiratory and Expiratory Valves



General Guidelines for Cleaning and Disinfection

The frequency, level, and need for disinfection of the Narkomed M is determined by the user facility based on the conditions of use and hospital infection control policy. Draeger Medical, Inc. recommends using disposable patient breathing circuits that can be replaced after single use.

If disinfection is required, first clean, dry, and then disinfect the Narkomed M and its parts according to the guidelines provided in this chapter. Determining the need and frequency of cleaning or disinfecting any particular component is the responsibility of the user facility. These procedures should be performed according to procedures established by the user facility, following the specific instructions provided by the manufacturer of the equipment or agent used.

For additional information about infection control practice, refer to the *APIC Guideline for Selection and Use of Disinfectants*. This guideline was developed by the Association for Professionals in Infection Control and Epidemiology, Inc. and published in *AJIC* Vol. 24, No. 4 pp. 313-342, August 1996. The following table of recommended disinfection methods for the Narkomed M was adapted from the *APIC Guideline for Selection and Use of Disinfectants*.

Table 9-1. Disinfection Methods

Part	A	B	C	D	E	F
Exterior Painted, Plated, and Plastic Surfaces					X	X
Corrugated Breathing Hoses, Mask Elbow, and Breathing Bag	X	X	X	X		
Y-Piece and Face Mask		X	X	X		
Ventilator Bellows Assembly		X	X	X		
Ventilator Bellows Bottom Assembly		X				
Oxygen Sensor Capsule		X				
Oxygen Sensor Housing					X	X
Oxygen Sensor Housing Cover		X	X	X		
Breathing Pressure Sensor Adapter and Hose Assembly		X	X	X		
Inspiratory/Expiratory Valves	X	X	X	X		
PEEP		X				
Respiratory Volume Sensor		X				
Breathing System Pressure Gauge		X				
Absorber Canister Assembly and Dust Cup	X	X	X	X		
Absorber Assembly		X				
Vaporizer Exterior					X	X
Scavenger Interface (does not normally need disinfection)		X				
Corrugated Scavenger Hoses and Breathing Bag (does not normally need disinfection)	X	X	X	X		

- A** Heat sterilization, including steam or hot air (use manufacturer's recommendations)
B Ethylene oxide gas (use manufacturer's recommendations)
C Glutaraldehyde-based formulations (2%)
D Wet pasteurization at 70° C for 30 minutes after detergent cleaning
E Sodium hypochlorite (5.2% household bleach) 1:500 dilution (100 ppm free chlorine)
F Ethyl or isopropyl alcohol (70% to 90%)

CAUTION: To avoid damaging the Narkomed M:

- Do not use Betadine®, Povodine®, Sagrotan®, Mucocit®, acetone, ketone, xylene, or anesthetic agents for cleaning.
- Dilute cleaning agents before use by strictly following the manufacturer's instructions.
- Do not use abrasives such as steel wool, liquid abrasives, or powder abrasives on the machine.
- Do not let any liquid enter the interior of the machine.
- Do not submerge any part of the system, unless specifically instructed to do so in this manual.
- Do not pour or spray liquid directly on the machine during cleaning. Always moisten a soft-lint free cloth with the appropriate cleanser before applying it to the machine.
- Wipe any spills and cleanser off the equipment surfaces immediately.

**Cleaning and
Disinfecting
Exterior
Surfaces**

Clean painted, plated, and plastic surfaces of the Narkomed M with a soft lint-free cloth moistened with mild detergent and water. Follow up with a 70% to 90% diluted solution of ethyl or isopropyl alcohol or sodium hypochlorite (5.2% household bleach) at 1:500 dilution (100 ppm chlorine).

NOTE: Draeger Medical, Inc. makes no claims about the efficacy of these agents or this method of cleaning for infection control. Consult your hospital's infection control officer or epidemiologist.

**Cleaning and
Disinfecting
Corrugated
Breathing
Hoses, Mask
Elbow, and
Bag**

Contact with oxygen, ether, mineral or vegetable oils, phenols, cresols, terpenes, hydrocarbon solvents, chlorinated hydrocarbons, esters, or oxidizing acids hastens the deterioration process for rubber goods.

Check the hoses, mask elbow, and breathing bag often for signs of deterioration, including swelling, tackiness, or cracking. Replace the affected parts when any of these conditions are evident.

Thoroughly clean rubber goods with mild alkali detergent and water before disinfecting them. Then, thoroughly rinse them with water to remove all detergent. To prevent water spots, use distilled or demineralized water. Avoid using hard-bristle brushes that can cause damage.

Manufacturers of rubber goods recommend that reusable rubber goods be soaked in a liquid disinfection agent. Always follow the agent manufacturer's instructions for use.

CAUTION: Disinfectants containing phenol or phenyl compounds destroy rubber goods. Latex and rubber goods treated with disinfectants having a quaternary ammonium base will be damaged if subsequently autoclaved.

Use 2% glutaraldehyde-based formulations for more than 20 minutes or wet pasteurization at 70° C for 30 minutes after detergent cleaning.

Thoroughly rinse the corrugated hoses, mask elbow, and breathing bag after contact with chemicals. Use sterilized water to prevent contamination by tap water organisms. Thoroughly dry rubber goods before returning them to service.

The corrugated hoses, mask elbow, and breathing bag can be autoclaved at 121° C. However, such temperatures accelerate the natural aging of rubber goods. Autoclaved rubber goods can also harden over time as a result of the loss of softeners. Exposure to ozone or ultraviolet light also accelerates the natural aging of rubber goods. Reusable rubber goods can also be disinfected with ethylene oxide. After EtO processing, properly aerate rubber goods before returning them to service. Always follow manufacturer's instructions for these procedures.

CAUTION: Do not autoclave face masks. Autoclaving causes rapid deterioration of face mask cushions.

**Cleaning and
Disinfecting
the Y-Piece
and Mask**

The Y-piece and mask can be disinfected by wiping or immersion with glutaraldehyde-based formulations. EtO and wet pasteurization processes can also be used.

**Cleaning and
Disinfecting
the
Ventilator
Bellows**

The ventilator bellows and its bottom assembly are the only ventilator components that come in contact with the patient's breath. Refer back to "Cleaning and Disinfecting Exterior Surfaces" for instructions on cleaning and disinfecting the surface of the ventilator bellows canister.

Clean the bellows with a soft lint-free cloth moistened with mild alkali detergent and water, followed by a distilled water rinse. Let the bellows drip dry.

After cleaning, use wet pasteurization at 70°C for 30 minutes, a 2% glutaraldehyde-based solution, or an EtO process to disinfect the ventilator bellows. Follow manufacturer's guidelines for these procedures.

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Cleaning and Disinfecting the Ventilator Bellows Bottom Assembly

Clean the ventilator bellows bottom assembly with a soft lint-free cloth moistened with mild detergent and water, followed by a distilled water rinse. Allow the assembly to drip dry.

After cleaning, use an EtO process for disinfection. Follow manufacturer's guidelines.

Cleaning and Disinfecting the Oxygen Sensor Capsule

Wipe the oxygen sensor capsule with a soft lint-free cloth moistened with mild detergent and water. Make sure the capsule is dry before replacing it.

CAUTION: Do not immerse or autoclave the oxygen sensor capsule.

After cleaning the capsule, perform an EtO process at a temperature not exceeding 50°C. Aerate the sensor according to the manufacturer's instructions.

Cleaning and Disinfecting the Oxygen Sensor Housing

The oxygen sensor housing can be immersed for cleaning and disinfection. Use mild detergent and water for cleaning. For disinfection, follow up with either sodium hypochlorite (5.2% household bleach) 1:500 dilution (100 ppm free chlorine) or 70% to 90% ethyl or isopropyl alcohol.

Cleaning and Disinfecting the Oxygen Sensor Housing Cover

The oxygen sensor housing cover can be immersed or wiped during cleaning and disinfection. Use mild detergent and water for cleaning. For disinfection, follow up with a 2% glutaraldehyde-based formulation, wet pasteurization at 70°C for 30 minutes, or an EtO process.

Cleaning and Disinfecting the Breathing Pressure Sensor Adapter and Hose Assembly

Clean the assembly with a mild detergent and water applied with a soft lint-free cloth. Rinse the assembly with water. Dry the assembly thoroughly (for example, with a tube drying device).

CAUTION: Do not autoclave the breathing pressure sensor adapter and hose assembly.

Use a 2% glutaraldehyde-based formulation to disinfect the assembly. Rinse with distilled or sterilized water to prevent contamination by tap water organisms. Wet pasteurization or a cold-cycle EtO procedure can also be used. Follow the manufacturer's guidelines for proper aeration.

**Cleaning and
Disinfecting
the
Inspiratory
and
Expiratory
Valves**

The inspiratory and expiratory valves come into contact with the patient's breath. The oxygen sensor and breathing pressure sensor assembly must be removed and the valves disassembled for thorough cleaning and disinfecting.

Clean these parts with soft lint-free cloth moistened with mild alkali detergent and water. Dry the parts before reassembling.

The valve assemblies can be immersed in a 2% glutaraldehyde-based solution, wet pasteurized, gas disinfected, or autoclaved at a temperature not exceeding 121° C. The valve disks can also be autoclaved in certain instances, but should not be autoclaved routinely.

Be careful while handling the valve disks. Improper handling can damage them. After cleaning or disinfecting the inspiratory or expiratory valve assembly, verify that the valve disk and all internal pins are undamaged and that the valve disks are correctly reinstalled.

**Cleaning and
Disinfecting
the PEEP
Valve**

Set the PEEP valve to the minimum setting. Wipe the PEEP valve with a soft lint-free cloth moistened with mild detergent and water. Follow up with a distilled water rinse.

CAUTION: The PEEP valve cannot withstand immersion or the heat and pressure of autoclaving. Do not disassemble the PEEP valve itself for cleaning or disinfection.

The PEEP valve can be disinfected with an EtO process, followed by appropriate aeration. Follow the Manufacturer's instructions.

**Cleaning and
Disinfecting
the
Respiratory
Volume
Sensor**

Clean the sensor after each working day by running distilled water through the housing.

CAUTION: The respiratory volume sensor cannot withstand immersion or the heat and pressure of autoclaving.

After cleaning, dry the sensor with a hose-drying unit or allow it to dry overnight.

The respiratory volume sensor can withstand EtO processes. Use ethylene oxide gas at a temperature not exceeding 50°C. Follow the manufacturer's guidelines for proper aeration.

Lubricate the sensor bearings after two months of use or after 30 ethylene oxide processes (whichever comes first). Follow the instructions in the supplied Sensor Lubrication Kit. Do not use any lubricant other than the one provided in the Sensor Lubrication Kit.

**Cleaning and
Disinfecting
the
Breathing
System
Pressure
Gauge**

Wipe the pressure gauge assembly with a soft lint-free cloth moistened with mild detergent and water. Dry the assembly before reinstalling.

The gauge can be disinfected with ethylene oxide gas, followed by appropriate aeration. Follow the manufacturer's instructions.

CAUTION: The breathing system pressure gauge cannot withstand immersion or the heat and pressure of autoclaving.

**Cleaning and
Disinfecting
the Absorber
Canister
Assembly
and Dust
Cup**

Refer to the instructions provided earlier in this chapter under the heading, "Replacing the Absorbent" for instructions on removing the absorbent canister assemblies from the absorber.

Clean the canister frequently. Remove used absorbent and clean absorbent residues for the canister and gasket surfaces. Check the dust cup periodically. Empty and clean it when necessary.

WARNING: Absorbent is caustic. Avoid contact with the skin and eyes.

After removing the canister assemblies and dust cup from the absorber system, wash these parts with mild alkali detergent and water. The canister assembly and dust cup can be immersed or wiped with a soft lint-free cloth. Allow the parts to dry.

Several methods can be used for disinfection. Wet pasteurization, autoclaving, EtO, and immersion or wiping with 2% glutaraldehyde-based solution are all acceptable. If an EtO process is used, make sure the parts are properly aerated before returning them to service.

**Cleaning and
Disinfecting
the Absorber
Assembly**

Turn the APL valve control knob fully counterclockwise before cleaning or disinfecting the absorber system.

After cleaning use wet pasteurization at 70° C for 30 minutes to disinfect the absorber system assembly. The assembly can be autoclaved at a temperature not exceeding 121° C or an EtO procedure can also be used. Follow manufacturer's guidelines.

**Cleaning and
Disinfecting
the
Vaporizer
Exterior**

Refer to the *Dräger-Vapor 2000 Anesthetic Vaporizer Instructions for Use* for complete information about the vaporizer.

WARNING: Water and other liquids (with the exception of the appropriate anesthetic) that enter the vaporizer chamber can cause injury to the patient or form corrosive products that affect the function of the vaporizer.

CAUTION: Do not immerse the vaporizer or allow water or any other liquid to enter the fill or drain ports or fresh gas inlet or outlet ports. Any vaporizer suspected of contamination with water or any other liquid must be returned to Draeger Medical, Inc.'s Technical Service Department for a complete overhaul.

Additional care must be taken with halothane vaporizers. Halothane contains a stabilization additive called thymol, which evaporates more slowly than halothane, and collects in the vaporizer. Over time, thymol may decompose into compounds that affect the wick material and turn the halothane yellow.

If you see particles in the sight glass of a halothane vaporizer, or if the halothane turns yellow, rinse the vaporizer chamber with fresh halothane as follows:

1. Drain the discolored halothane from the vaporizer.
2. Fill the vaporizer with fresh halothane up to the maximum level, then drain completely.
3. Dispose of the drained halothane in accordance with standard practices at your facility.

For comprehensive information about filling and draining the vaporizer, refer to the *Dräger-Vapor 2000 Anesthetic Vaporizer Instructions for Use*.

Clean the vaporizer exterior with a soft lint-free cloth moistened with mild detergent and water. Follow up with a 70% to 90% diluted solution of ethyl or isopropyl alcohol or sodium hypochlorite (5.2% household bleach) at 1:500 dilution (100 ppm chlorine). Do not sterilize the vaporizer.

Cleaning and Disinfecting the Scavenger Interface

The scavenger interface does not normally need to be disinfected. However, if the user facility requires disinfection, an EtO process can be used after cleaning. Refer back to the cleaning instructions provided under the "Routine Maintenance" section in this chapter.

Cleaning and Disinfecting the Scavenger Hoses and Bag

The scavenger hoses and bag are not part of the breathing circuit, so they do not require disinfection. If the user facility requires disinfection, refer back to the instructions provided in "Cleaning and Disinfecting Corrugated Breathing Hoses, Mask Elbow, and Bag" to select a compatible process.

Check the hoses frequently for signs of deterioration, including swelling tackiness, or cracking. Replace the affected parts when any of these conditions are evident.

Reassembly Instructions

Make sure all parts are completely dry and adequately aerated before reassembling the machine after cleaning and disinfection procedures.

1. Place the ventilator bellows on the bellows bottom assembly and turn it in a clockwise direction.
2. Fit the bellows assembly into the ventilator bellows canister and tighten the two wing nuts.
3. Reassemble the inspiratory and expiratory valves by replacing the valve disk and dome gasket in the valve body, then replacing the dome and ring nut. Turn the ring nut counterclockwise to tighten.
4. Replace the inspiratory valve assembly and gasket on the valve mount of the absorber dome. Turn the valve assembly clockwise to secure it to the valve mount.
5. Replace the canister assembly in the absorber assembly and tighten the two wing nuts that secure the canister assembly to the absorber.
6. Replace the dust cup, making sure the o-ring is in place.
7. Place the absorber mounting stud on the absorber pole. Loosely tighten the upper wing screw to lock the assembly to the absorber pole.
8. Loosen the lower wing screw to raise the absorber system to the preferred height. Tighten the wing screw to hold the absorber at that height.
9. Loosen the upper wing screw and rotate the absorber system to the preferred position. Tighten the upper wing screw to hold the absorber in position.

WARNING: Do not pinch or kink the fresh gas hose leading from the fresh gas outlet to the absorber.

10. Connect the fresh gas hose to the fresh gas outlet on the machine.
11. Replace the respiratory volume sensor. Make sure the gasket is in place before fitting the sensor on the lower absorber pipe and tightening the retaining nut.
12. Replace the PEEP valve. Make sure the gasket is in place over the respiratory volume sensor connection before placing the PEEP valve and tightening the retaining nut.

13. Replace the expiratory valve. Make sure the gasket is in place over the PEEP valve connection before turning the expiratory valve clockwise until it is secure.
14. Connect the respiratory volume sensor to the system interface panel.
15. Press the pressure sensor adapter and hose assembly into the inspiratory valve dome.
16. Connect the quick-connecting fitting to the pressure gauge.
17. Connect the breathing pressure pilot line connector to the system interface panel.
18. Place the oxygen sensor back into the oxygen sensor housing. Verify that the rings on the capsule face the electrical contacts in the sensor housing.
19. Replace the sensor housing cover and turn it clockwise until it is secure against the housing.
20. Push the tip of the sensor housing cover back into the breathing pressure sensor assembly.
21. Plug the oxygen sensor connector into the system interface panel.
22. Place the pressure gauge assembly on the gauge mount. Be sure to keep the o-ring with the pressure gauge assembly.
23. Turn the nut that connects the pressure gauge to the gauge mount clockwise.
24. Check the gauge needle's zero position and adjust it if necessary.
25. Replace the 22 mm hoses and other breathing circuit accessories as illustrated.

Figure 9-13. Replacing 22 mm Hoses and Other Breathing Circuit Accessories (1 of 2)

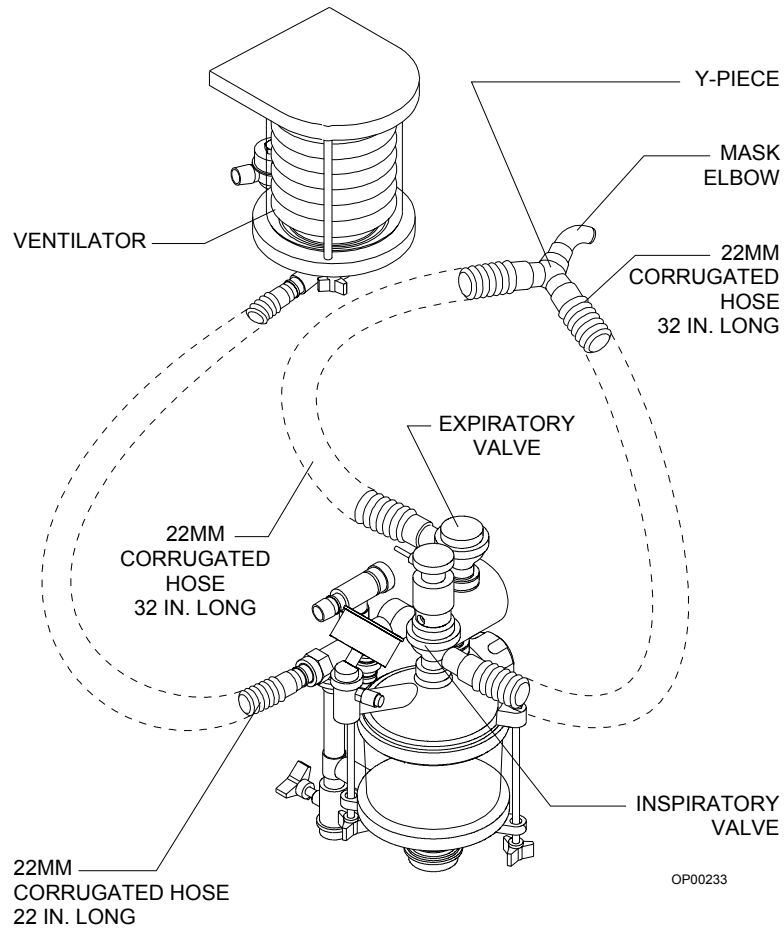
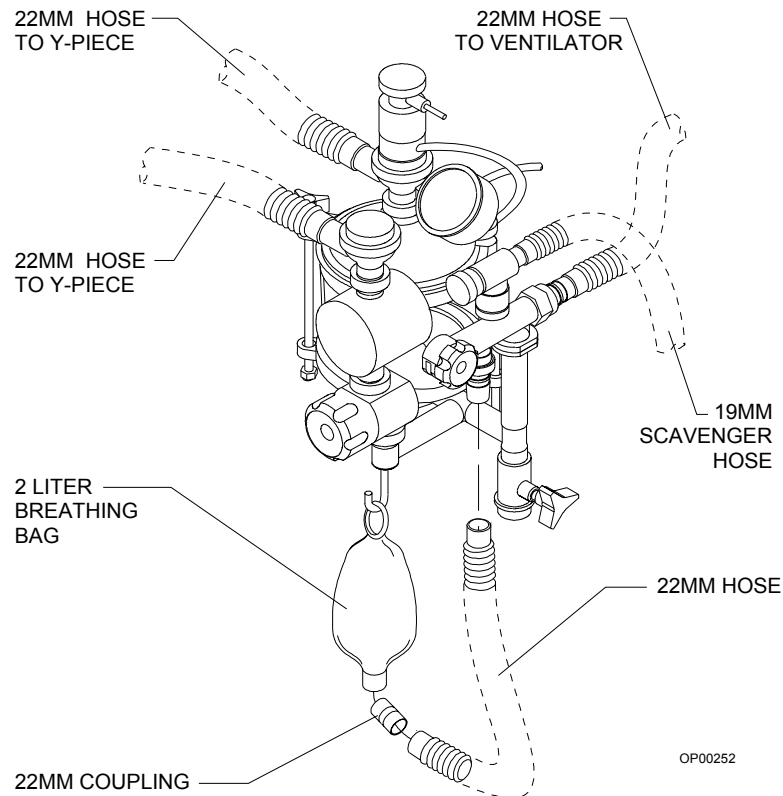


Figure 9-14. Replacing 22 mm Hoses and Other Breathing Circuit Accessories (2 of 2)



26. Replace the 19 mm hoses (and bag if a suction system is used) that connect the APL valve and ventilator relief valve to the scavenger as illustrated on the following pages.
27. Turn the System Switch on.
28. Perform the Daily Checkout procedure provided in this manual before operating the machine.

Figure 9-15. Replacing the 19 mm Hoses (1 of 2)

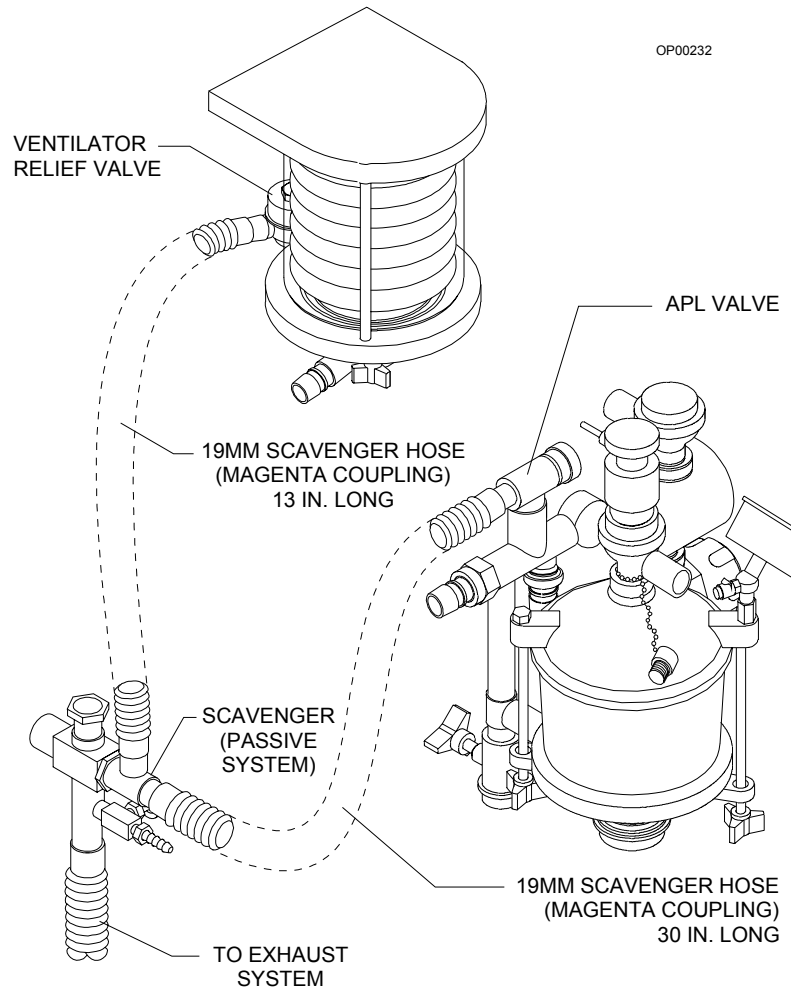
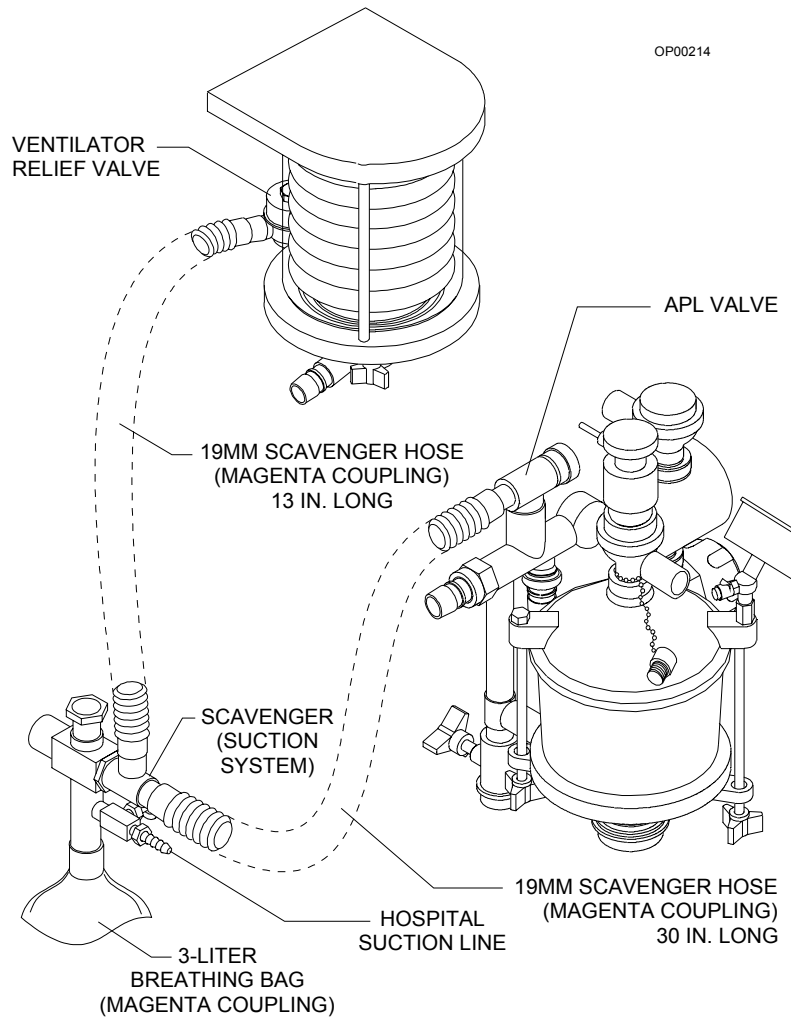


Figure 9-16. Replacing 19mm Hoses (2 of 2)



Troubleshooting

Absorber System Problem Resolution

PROBLEM	POSSIBLE CAUSE	REMEDY
Erratic breathing system pressure gauge readings with gurgling sounds in equipment during AUTO mode.	Moisture accumulation in ventilator hose.	Switch to manual ventilation. Remove ventilator hose from the back of the manual/automatic selector valve block. Drain hose, reconnect, and return to automatic ventilation.
Erratic breathing system pressure gauge readings with gurgling sounds in equipment during BAG mode.	Moisture accumulation in scavenger hose that leads from bottom of absorber pole to scavenger system.	Remove scavenger hose from bottom of absorber pole. Drain hose and reconnect.
System has pressure but flow does not cycle correctly.	Misconnected hoses.	Check all hose connections according to the instructions provided in this manual.
System is over-pressurized.	PEEP valve is on when no PEEP is required.	Turn the PEEP valve off.
	APL valve resistance is set too high.	Adjust APL valve counterclockwise.
	Automatic ventilation malfunction.	Switch to manual ventilation.
	Ventilator relief valve adjustment set incorrectly.	Contact a qualified service representative to adjust ventilator relief valve.

PROBLEM	POSSIBLE CAUSE	REMEDY
Failure of system to pressurize properly or sudden loss of pressure.	Low fresh gas supply.	Increase fresh gas supply.
	Occluded fresh gas supply.	Inspect hose. Restore free flow.
	Disconnection of fresh gas hose.	Check and secure fresh gas hose connection.
	Manual/automatic selector valve improperly positioned.	Correct manual/automatic selector valve position.
	Disconnected hose.	Check all breathing system hoses. Reconnect loose hoses.
	Leaking hose.	Check integrity of all breathing system hoses.
	APL valve resistance is set too low.	Adjust APL valve clockwise to required pressure.
	Loose unidirectional valve or fitting.	Check unidirectional valves and all joints and fittings for tightness. All gaskets and O-rings must be in place.
	Chipped canister rim.	Replace canister.
	Canister subassembly is loose.	Make sure the wing screws securing the canister assembly are tight.
	Ruptured gauge diaphragm.	Replace gauge.

Troubleshooting

10

PROBLEM	POSSIBLE CAUSE	REMEDY
Absorbent is purple.	Ethyl violet indicator shows absorbent is exhausted. Other indicators exhibit different color changes.	Replace with fresh absorbent.
High CO ₂ levels.	Depleted absorbent.	Replace with fresh absorbent.

Ventilator Problem Resolution

PROBLEM	POSSIBLE CAUSE	REMEDY
Excessive PEEP	Improperly adjusted ventilator relief valve	Contact a qualified technical service representative.
	Insufficient suction scavenger flow setting	Increase suction scavenger flow valve.
	PEEP valve active	Decrease PEEP valve setting.
	Inverse I:E ratios	Reset ratios.
Excessive PEEP	Excessive suction scavenger flow	Reduce suction scavenger flow rate.
Bellows won't reach tidal volume stop setting during expiration	Frequency too high for selected tidal volume	Decrease frequency.
		Increase expiratory phase time.
	Improperly adjusted ventilator relief valve	Contact a qualified technical service representative.
	Breathing system leak	Repair leak.
Ventilator won't cycle	Low oxygen supply pressure	Provide sufficient oxygen supply pressure.
Bellows won't compress during inspiration	Absorber manual/automatic selector valve in BAG position	Place selector valve in AUTO position.
	Inspiratory flow control setting on ventilator too low	Increase inspiratory flow control setting.
	Frequency too high	Decrease frequency.

Oxygen Monitoring Problem Resolution

PROBLEM	POSSIBLE CAUSE	REMEDY
Display area remains blank when a reading is expected. CAL O2 SENSOR message in Alarm window.	Needs calibration	Perform proper calibration. Remove sensor assembly from breathing circuit. Make sure sensor is exposed to room air only. Then press the Cal key.
O ₂ analyzer fails to retain calibration. Alarm message CAL O2 SENSOR appears in Alarm window.	Backup memory power not available	Check battery circuit breaker. Allow backup battery to recharge, and recalibrate the analyzer.
	Hardware malfunction	Contact a qualified technical service representative.
Pressing Cal does not initiate calibration.	Sensor is disconnected	Insert sensor cord connector into Oxygen Sensor receptacle in the system interface panel.
	Sensor cord is damaged	Replace housing/cord assembly.

PROBLEM	POSSIBLE CAUSE	REMEDY
Pressing Cal initiates calibration, but Oxygen Monitor window is blank at end of calibration period	Sensor is exposed to incorrect oxygen concentration	Expose sensor to room air for 21% calibration.
	Sensor exposed to constantly changing calibration mixture	
	Sensor capsule was removed from housing for a prolonged period	Allow a waiting period equal to duration of capsule removal.
	New capsule not given proper waiting period	Allow a 15 minute waiting period.
	Exhausted or defective sensor capsule	Replace sensor capsule. Allow a 15 minute waiting period.
O2 SENSOR DISC message appears in Alarm window during monitoring	Defective sensor housing and cable	Replace housing/cable assembly.
	Sensor cord is disconnected	Insert sensor cord connector into Oxygen Sensor receptacle in the system interface panel.

Respiratory Volume Monitoring Problem Resolution

PROBLEM	POSSIBLE CAUSE	REMEDY
Blank display area	One full minute has not elapsed (Minute Volume and Respiratory Rate) since respiration began	Wait one minute to read display.
	Apnea condition	Correct condition.
Blank display area, VOL SENSOR DISC alarm message in Alarm window	Sensor cord disconnected	Reconnect sensor cord connector to the Volume Sensor receptacle in the system interface panel.
	Sensor cord damaged	Repair sensor cord.
REVERSE FLOW alarm message in Alarm window	Leak between sensor and expiratory valve	Check gasket. Make sure it is in good condition and is seated properly.
	Expiratory valve not closing completely during inspiration	Check expiratory valve disc and pins. Clean, repair, or replace expiratory valve.
	Failed sensor	Repair or replace sensor.
Tidal volume readings obtained are consistently low and sensor is noisy during operation	Excessive friction in sensor	Lubricate, repair, or replace sensor.

Breathing Pressure Monitoring Problem Resolution

PROBLEM	POSSIBLE CAUSE	REMEDY
No pressure readout in display area during ventilation	Breathing pressure hose assembly not connected properly	Make sure the assembly is properly connected.
	Hose is blocked or kinked	Make sure that assembly is free of obstructions.
Erratic readings	Condensation accumulation in the hose	Drain and reconnect breathing pressure hose assembly.

Spare and Replacement Parts

	Description	Part Number
Documentation	Narkomed M Operator's Instruction and Setup Manual	4114107
	Narkomed M Technical Service Manual	4114108
	Assembly/Disassembly Instructions (setup card)	4114362
Absorber System	Gasket - Canister Top	4105848
	Screen - Canister	1100022
	Canister (includes bottom gasket)	4105851
	Breathing Pressure Gauge Assembly	4114290
	Dome - Expiratory Valve (without port)	2109230
	Dome - Inspiratory Valve (with sensor port)	4108329
	Plug Assembly - (for inspiratory valve dome with sensor port)	4106387
	Valve Assembly - Inspiratory (with ported dome assembly and plug assembly)	4112773-001
	Valve Assembly - Expiratory	4112150
	Gasket (valve dome)	2109231
	Gasket (flat washer, inspiratory or expiratory valve mount)	1101690
	Dust Cup	4114094
	O-ring #335, EPDM (dust cup fitting)	4114167
Breathing System Accessories	Breathing Hose, 22 mm x 22" long	9995123
	Breathing Hose, 22 mm x 32" long	9995132
	Breathing Bag Connector	4114312
	Rubber Goods Set (includes Y-piece, mask elbow, 2-liter breathing bag, two 22 mm corrugated hoses, 32" long)	1101071
	Pediatric Rubber Goods Set (includes Y-piece, mask elbow, 0.5-liter breathing bag, two 22 mm corrugated hoses, 30" long)	4114356
	Newborn Facemask	9995001
	Infant Facemask	9995002
	Adult Facemask	9995005

A	Spare and Replacement Parts	
	Description	Part Number
Gas Evacuation Accessories	Hose, 22 mm x 22" long	9995123
	Hose, 19 mm x 13" long	9995213
	Hose, 19 mm x 30" long	9995230
	Scavenger 3-liter breathing bag, 19 mm connection.	9995430
Breathing Bag	2-liter.	9995320
Vaporizer Dräger- Vapor 2000	O-rings (vaporizer mount).	4114346
Bellows	Adult Latex-Free Bellows	4114102
	Adult Latex-Free Bellows Subassembly	4106930-001
Oxygen Monitoring Accessories	Oxygen Sensor Capsule	6850645
	Sensor Housing and Cable Assembly	4106363
Respiratory Volume Monitoring Accessories	Volume Monitor Sensor Assembly	4106362
	Volume Sensor Lubrication Kit (supplied with Sensor Assembly)	2218180
	Gasket (expiratory valve mount and sensor inlet).	1101690
Pressure Monitoring Accessories	Breathing Pressure Hose Assembly	4114281
Scavenger	Universal Scavenger	4114255
Pipeline Supply Hoses	Hose ASM-N ₂ O DISS Hand 10L	4113712-010
	Hose ASM-Air DISS Hand 10L	4113713-010
	Hose ASM-O ₂ DISS Hand 10L	4113714-010
Other Acces- sories	Adapter ASM-Test Terminal.	4104389
	Power Cord - 6 feet	4110334
	Cable Translator Adapter	4114359
	Mesh Storage Basket.	4114272

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